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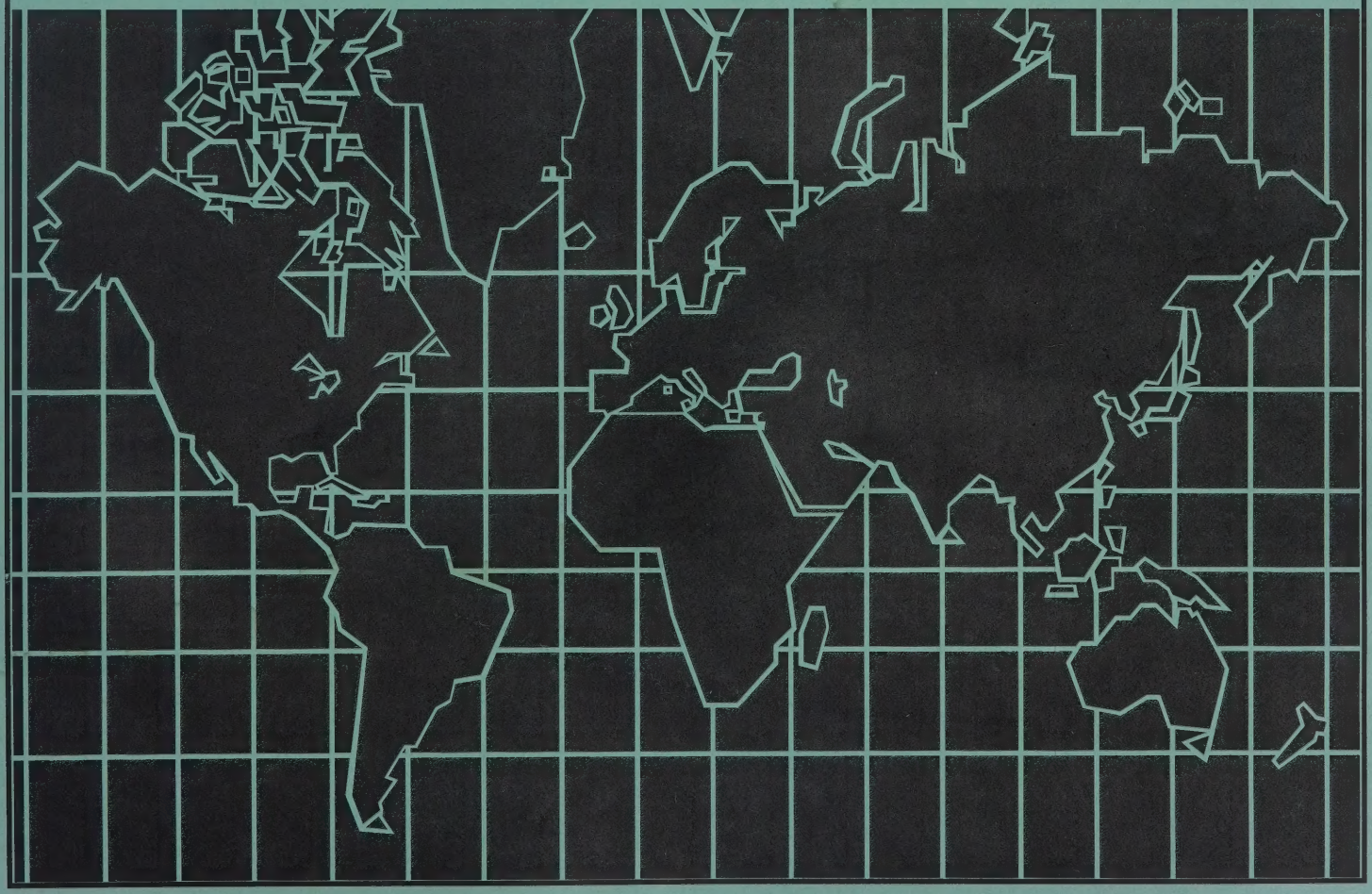
Proceedings from the Seventh Annual MOSS User's Conference

Portland, Oregon
November 26-30, 1990

Hosted by:
U.S. Forest Service, Region 6
Bureau of Land Management, Oregon State Office



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PREFACE

The Seventh National MOSS Users Workshop was held at the Greenwood Inn, Portland, Oregon, Novemeber 26-30, 1990. It was hosted by the U.S. Forest Service, Region 6 and the Bureau of Land Management, Oregon State Office.

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WODDB SOFTWARE:

PROBLEMS AND ACCOMPLISHMENTS

Presented to:

The Seventh National MOSS Users Conference
November 29, 1990 - Portland, Oregon

by

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I. Introduction.

What follows is a summary the presentation I gave at the Conference. It is organized around the overheads that were used. Copies of the overheads are attached.

II. WODDB SOFTWARE: PROBLEMS AND ACCOMPLISHMENTS

WODDB stands for Western Oregon Digital Data Base. The WODDB Project consists of developing a cartographic data base of all Bureau of Land Management lands in Western Oregon and using this data base for cartographic analysis. Moss was the primary tool for implementing this data base.

III. GOALS OF PRESENTATION.

A. Overview of WODDB Software

This talk describes, at a high level, the software developed in support of the WODDB Project over the past 3 years. Six data flow diagrams are provided to give a pictorial view of the phases of software development. These data flow diagrams consist of a top level view encompassing all WODDB software and 5 lower level diagrams detailing the programs and processes of each phase.

B. Overview of Major Programs

Each major program is described by name, implementation language, function, etc.

C. Problems and Accomplishments

The emphasis of this talk will be on problems encountered while developing the software and how those problems were solved or circumvented.

IV. Data Flow Diagram #1: WODDB Software.

This diagram shows the 6 major processes of WODDB:

* Autocad Processing
* Create Moss Maps
* Attribute Moss Maps
* Analyze Moss Maps
* Moss to DXF
* Update Moss Maps

Each of these processes is described in more detail in subsequent sections.

V. Data Flow Diagram #2: Autocad Processing

This diagram shows the 4 major processes that take place in the Autocad environment. The Digitize Maps and DXF Out processes are part of the Autocad package. The other two processes are described below.

A. EDGETIE PROGRAM

** Adjusts end points to match adjacent maps

WODDB maps are broken into rectangular sections for digitizing purposes. Once digitized, the sections must be aligned along section boundaries and assembled into larger units. Because of the inevitable errors introduced by the computer assisted digitizing process, map sections often do not align properly. For example, a road in one map section may not align properly with its continuation in the next map section. Furthermore, errors of this type may be hard to see but result in serious errors in later processing.

The solution is to write software to identify and correct misaligned line segments at map boundaries. The EdgeTie program performs this task.

** Removes gaps in map lines

Similarly, the digitizing process can leave small gaps in lines. EdgeTie also locates and corrects these gaps.

** AutoLisp and C

The EdgeTie program is written in AutoLisp with some subroutines written is C.

** High quality user interface

The EdgeTie program has a fully developed user interface with pull-down menus.

B. SELECT PROGRAM

** Selects existing lines to create new area boundaries

One requirement of WODDB is the ability to select lines along a path of an existing map and create a new map with the path selected. This is the function of the Select program.

** AutoLisp and C

The Select program is written in AutoLisp with subroutines written is C.

** Used Btrieve from C to build data base of line segments

The line segment selection process of Select requires that a large number of possible line segments be examined to find all line segments that connect to a given node. Early versions of Select ran very slow because of the considerable search time required.

A rather novel solution to this problem was found using techniques more often associated with data processing than GIS.

Line segments are defined by start and end points. Polylines consist of multiple line segments where the end point of one segment is the start point of the next. Using this fact, a data base was built using a purchased data base package called Btrieve. The data base consisted of a table with one row per line segment with the start point as the master key for the rows. Using this table, a line segment could be located using its start point, its end point extracted from the row and this end point used to look up new start points for all line segments that attach to the given line segment. In this way the program was able to locate all candidates for path tracing in an efficient manner. The Btrieve software was run from C subroutines and the results passed back to the main AutoCad program.

** High Quality User Interface

Like EdgeTie, Select has a high quality user interface using pull-down menus. This is particularly important because of the inherently interactive character of the line tracing process.

VI. Data Flow Diagram #3: Create Moss Maps

This diagram shows the major processes required to translate maps for the AutoCad DXF format to the Moss township based format.

A. FEET/METERS CONVERSION PROGRAMS

** DXF To DXF Conversion

This is a very simple program that converts DXF files from units of feet to meters as required by Moss.

** FORTRAN 77

B. BASE SPLIT PROGRAM

** Separates map layers (themes) into separate map files

The AutoCad DXF files have multiple map themes together in

one file. The program that converts DXF format file to ADS format files requires one map theme per file. The Base Split program separates the themes as required.

** FORTRAN 77

** DXF To DXF Conversion

Base Split takes a DXF file as input and produces multiple DXF files, one per map theme.

C. DXF TO ADS PROGRAM

** Translates Autocad DXF files to ADS files

AutoCad is a drawing package that is well suited for digitizing maps. However, AutoCad maps consists of points and lines but not of polygons. More accurately, the way AutoCad stores its data does not allow for the identification of polygons as map data structures. Moss however, must be able to recognize certain collections of line segments as forming closed polygons. Translating line segments into recognized polygons is called Polygon Closure. In general, Polygon Closure algorithms are complex and expensive to develop.

However, there was available to us a program called the Automated Digitizing System (ADS) that already had a fully functioning Polygon Closure function. Furthermore, ADS has a ADS to Moss translation program. This meant that if the AutoCad DXF file could be translated to ADS, then both polygon closure and translation to Moss could be done quickly and easily. DXF to ADS is the program that does this translation.

** FORTRAN 77

** Also: Adds new nodes to lines
Removes duplicate lines

Because the translation process from DXF to ADS requires that the DXF file be deconstructed and loaded into tables, other unrelated types of processing on the DXF were also added to this program. Specifically, nodes were added to certain line crossings and duplicate lines were removed.

** Complex, High maintenance program

This program proved to be the single most difficult of all the WODDB software to developed. There were two reasons for this. First, the translation itself was difficult because the DXF and ADS file structures are quite different. Second, adding additional and largely extraneous functions

to the translation process compromised the functional integrity of the program and made debugging very difficult.

Despite all this, the program has successfully translated thousands of maps and is the center peice of the AutoCad/Moss architecture of the WODDB system.

D. PRODUCTION DRIVER PROGRAMS

** Drives all processes required to produce an unattributed map

The WODDB project requires that thousands of maps, some quite large, be processed. Moss, on the other hand, was developed as a single user interactive system. In order to use Moss and the other software in a large scale production environment, software drivers needed to be developed to coordinate and track the running of the many programs required. This is the role of the Production Driver software.

** Over 80 CPL programs

The Production Driver software is written in the Prime Command Processor Language (CPL). CPL is a text generating program that feeds commands to the Prime operating system (PRIMOS). The system consists of a large library of coordinated subroutines. This system allows the unattended processing of hundreds of maps in one batch job.

** Tracking of all processes

Equally important is the ability to track the processing of the maps. The Production Driver software includes a tracking system that records every process applied to a map along with date/time stamps.

VII. Data Flow Diagram #4: Attribute Moss Maps

This diagram shows the major processes required to attribute Moss maps. Process 2 shows the Network Transfer of ASCII data extracted in the BLM district offices from PC based data bases. This data is then used by Oregon State Office Prime to attribute the Moss maps.

A. DBLINK PROGRAM

** Automates the process of attributing MOSS maps

The Moss process for adding attributes to Moss subjects was intended as an interactive on-line process. The WODDB project, however, requires that large numbers of maps be attributed in an automated manner. The Dblink program serves this role. The control information for Dblink

consists of three files in 3rd normal form format. A Build file whose records have the attributes for building a single Moss multiple attribute file. A Field file whose records have the attributes for building a single Moss multiple attribute field. And a Build_Field file that assigns multiple Field records to a single Build record. Dblink uses Moss utility option 5, Sub2at, to associate subjects with items. Once this is done the data is massaged into a form that can be used drive the attribution process using the control files to "feed" the Moss prompts.

** Compiled CPL, Some modules rewritten in C

The first version of Dblink was run in native CPL. This proved to be a problem due to the slowness of native CPL I/O. To solve this problem, a CPL compiler was purchased. The compiled CPL ran about twice as fast overall. This was still not adequate, so timing studies were done and several slow routines were rewritten in C. The current version of Dblink runs about 18 times faster that the original.

** Low cost solution: lacks fully developed user interface

A conscious decision was made to train expert users for Dblink rather than develop a sophisticated user interface. This reduced costs and freed up development time for programs such as DXF to ADS that proved to be more difficult that budgeted for.

VIII. Data Flow Diagram #5: Analyze Moss Maps

This diagram shows the major processes required to analyze the Moss data. This is a very high level diagram summarizing a wealth of analytical processes.

A. ORACLE/MOSS LINK PROGRAMS

** Stores MOSS produced data for analysis and delivery

Moss does not provide the full features of a relational data base package for analyzing data. Therefore the decision was made to load analysis results from Moss into Oracle tables for later processing and analysis.

** CPL/SQL

The data was loaded by directing Moss output to a Primos Como file and using CPL programs to extract the required data from the Como file and load the Oracle tables.

** Quality Control and Tracking of Processing

In addition, Oracle tables are built that contain tracking

information, control totals, etc. This has proved invaluable in verifying the correctness of the analysis results and detecting any required rework.

B. PRODUCTION MOSS DRIVERS

** Drives MOSS analytical processes

A typical analysis process would be to calculate the acreage of harvestable timber given specific buffer sizes around known spotted owl nests. Again, the use of Moss drivers allows large numbers of maps to be processed in a batch mode.

** CPL

** Handling of exceptional MOSS conditions: MOSS IF statement

Moss has a BSEARCH statement that allows new maps to be built from old as required by the given analysis process. Each map selected in this way is assigned an id number. However, if no data is selected the id number is not assigned. This creates a problem for the CPL driver programs because CPL has no way of knowing that the Moss BSEARCH has failed. The solution to this problem was to have a new statement added to Moss. The new statement is called IF. The IF statement indicates whether a given BSEARCH was successful or not. The IF statement was used to invoke a Moss SYSTEM command that sets a Primos global variable. The CPL program can then reference the global variable and know whether the given BSEARCH was successful. In this way a critical feedback mechanism from Moss to CPL was established.

IX. MOSS TO DXF PROGRAM

** Translates Point and Line data from MOSS to DXF format

The intent of this program was to translate Moss maps back into Autocad for update, etc.

** FORTRAN 77

** Problem: Polygon translation failed

However, for reasons discussed below, the polygon translation was never achieved. Only point and line data is translatable back to AutoCad.

** MOSS rounding errors fragmented shared polygon boundaries. Could not reconstruct correct map boundaries.

Moss rounding errors produce polygon boundaries that are

fragmented. Once fragmented, it is impossible to reconstruct the original boundaries between adjacent polygons. This made the translation of polygon maps from Moss to Autocad computationally infeasible.

X. Data Flow Diagram #6: Update Moss Maps

This diagram shows the major processes required to update Moss maps. The original intent was to translate Moss maps back to AutoCad for update and then retranslate back to Moss. However, because of the failure to find a way to translate polygon maps from Moss to Autocad, this approach was abondoned. Instead, the decision was made to store the master maps as ADS maps. ADS is then used to update the maps using its digitizing facilities. The updated maps are then retranslated into Moss using the Moss to ADS function of ADS.

XI. DEVELOPERS

** EDGETIE: Terry Locke

** SELECT:
Design and AutoLisp: Terry Locke
C: Markus Mattwandel
Line Tracing Algorithm: James Archer

** PRODUCTION DRIVERS, DBLINK: James Archer

** DXF TO ADS, BASE SPLIT
Original Development: Kurt Modahl
Coding: Shuo Li
Modifications: Tuyen Ngo

** ORACLE/MOSS LINK: Terry Locke

** MOSS TO DXF, PRODUCTION MOSS DRIVERS: Markus Mattwandel

XII. CONCLUSIONS

** POWER OF CPL

If you have to spend several years writing driver programs for Moss, ADS, etc., then CPL is the language to use! The more we have worked with Prime CPL, the more impressed we have become with its power and flexibility. CPL is one of the finest command processing languages ever written.

** DIFFICULTIES OF TRANSLATION

We have found that translating maps from one format to another is a very difficult and error prone process. This

is because map formats are usually developed to meet the needs and conceptions of the a given software package with little attention given to the formats required by other packages. In some cases, data required by one format may not even exist in the other.

** NEED TO ADAPT TO TECHNICAL PROBLEMS

Major technical problems sometimes require a major rethinking of system architecture. The decision to store master maps in ADS is an excellent example of this kind of rethinking.

** VALUE OF RELATIONAL DATA BASES IN SUPPORT OF GIS

To get the full benefit of GIS, a fully relational data base of map attributes is required. Moss does not provide this, so Oracle was used to provide the required facilities.

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WODDB SOFTWARE:

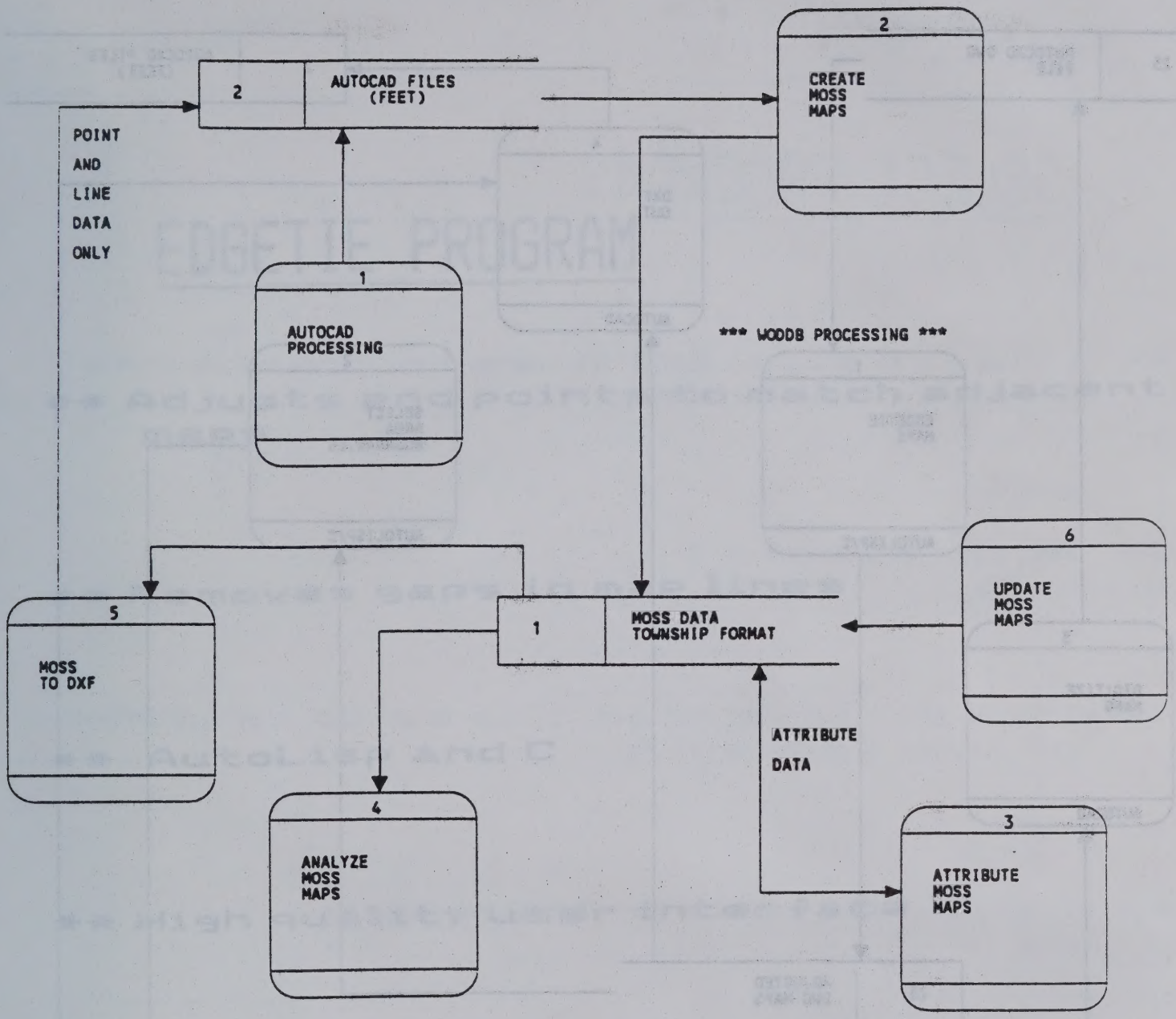
PROBLEMS AND ACCOMPLISHMENTS

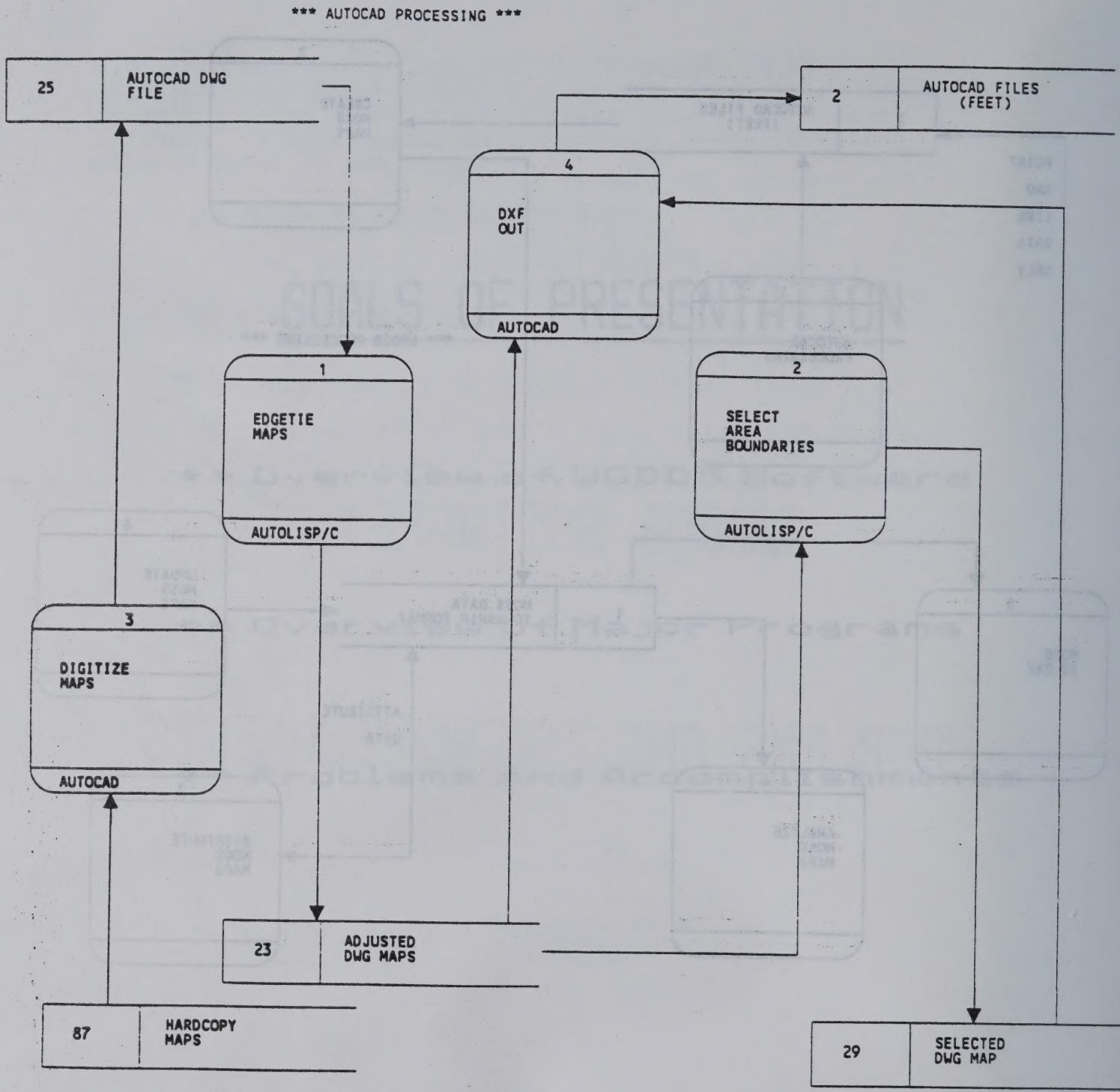
GOALS OF PRESENTATION

** Overview of WODDB Software

** Overview of Major Programs

** Problems and Accomplishments


2
2
AUTOCAD FILES
(FEET)
CREATE
MOSS
MAPS
POINT
AND
LINE
DATA
ONLY
1
AUTOCAD
PROCESSING
*** WODDB PROCESSING ***
6
UPDATE
MOSS
MAPS
5
MOSS
TO DXF
1
MOSS DATA
TOWNSHIP FORMAT
ATTRIBUTE
DATA
4
ANALYZE
MOSS
MAPS
3
ATTRIBUTE
MOSS
MAPS


*** AUTOCAD PROCESSING ***
25
AUTOCAD DWG FILE
2
AUTOCAD FILES (FEET)
4
DXF OUT
AUTOCAD
1
EDGETIE MAPS
AUTOLISP/C
2
SELECT AREA BOUNDARIES
AUTOLISP/C
3
DIGITIZE MAPS
AUTOCAD
23
ADJUSTED DWG MAPS
87
HARDCOPY MAPS
29
SELECTED DWG MAP

EDGETIE PROGRAM

** Adjusts end points to match adjacent maps

** Removes gaps in map lines

** AutoLisp and C

** High quality user interface

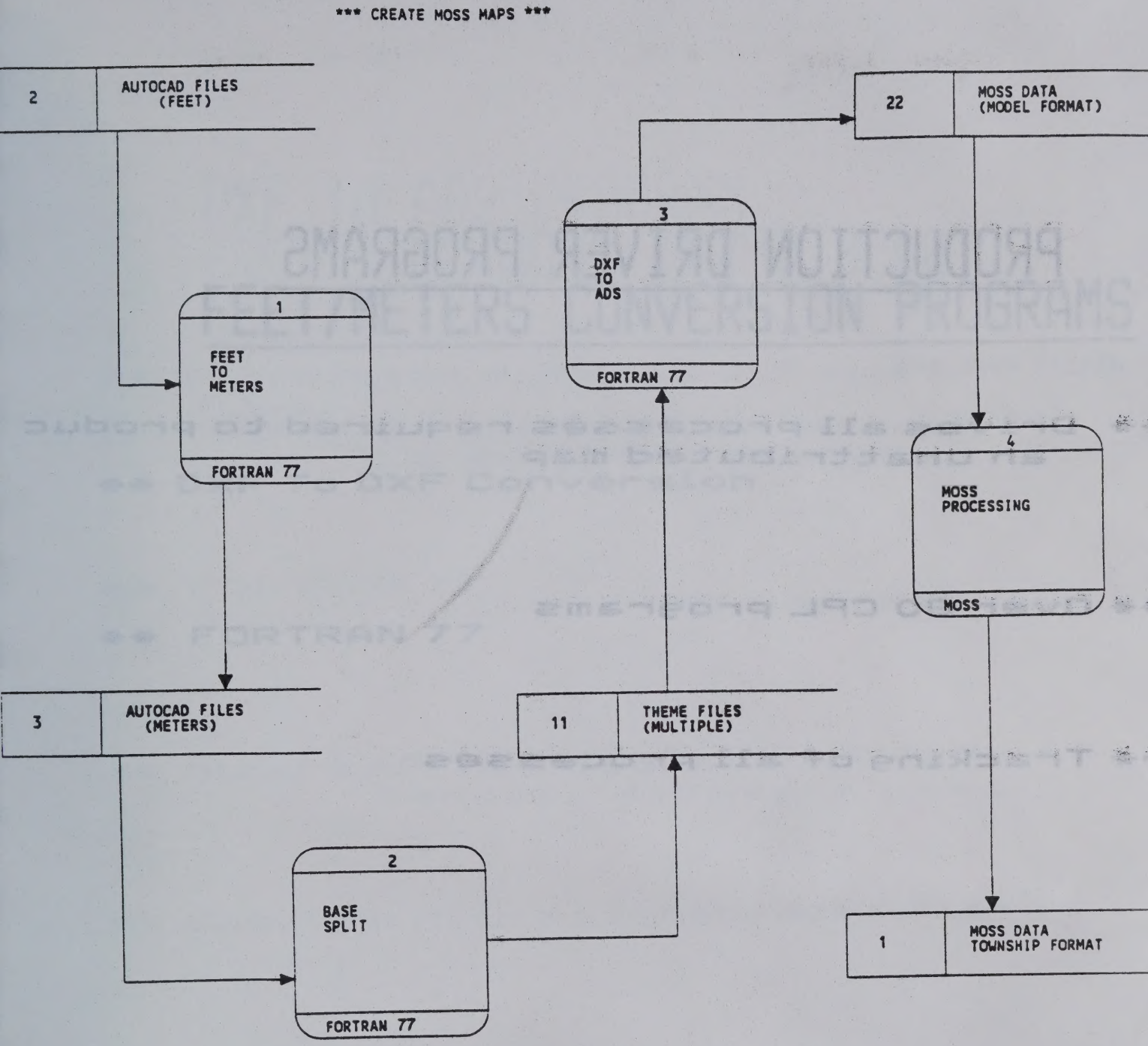
SELECT PROGRAM

** Selects existing lines to create new area boundaries

** AutoLisp and C

** Used Btrieve from C to build data base of line segments

** High Quality User Interface


*** CREATE MOSS MAPS ***
2
AUTOCAD FILES (FEET)
22
MOSS DATA (MODEL FORMAT)
3
DXF TO ADS
FORTRAN 77
1
FEET TO METERS
FORTRAN 77
4
MOSS PROCESSING
MOSS
3
AUTOCAD FILES (METERS)
11
THEME FILES (MULTIPLE)
2
BASE SPLIT
FORTRAN 77
1
MOSS DATA TOWNSHIP FORMAT

PRODUCTION DRIVER PROGRAMS

** Drives all processes required to produc
an unattributed map

** Over 80 CPL programs

** Tracking of all processes

FEET/METERS CONVERSION PROGRAMS

** DXF To DXF Conversion

** FORTRAN 77

BASE SPLIT PROGRAM

** Separates map layers (themes) into separate map files

** FORTRAN 77

** DXF To DXF Conversion

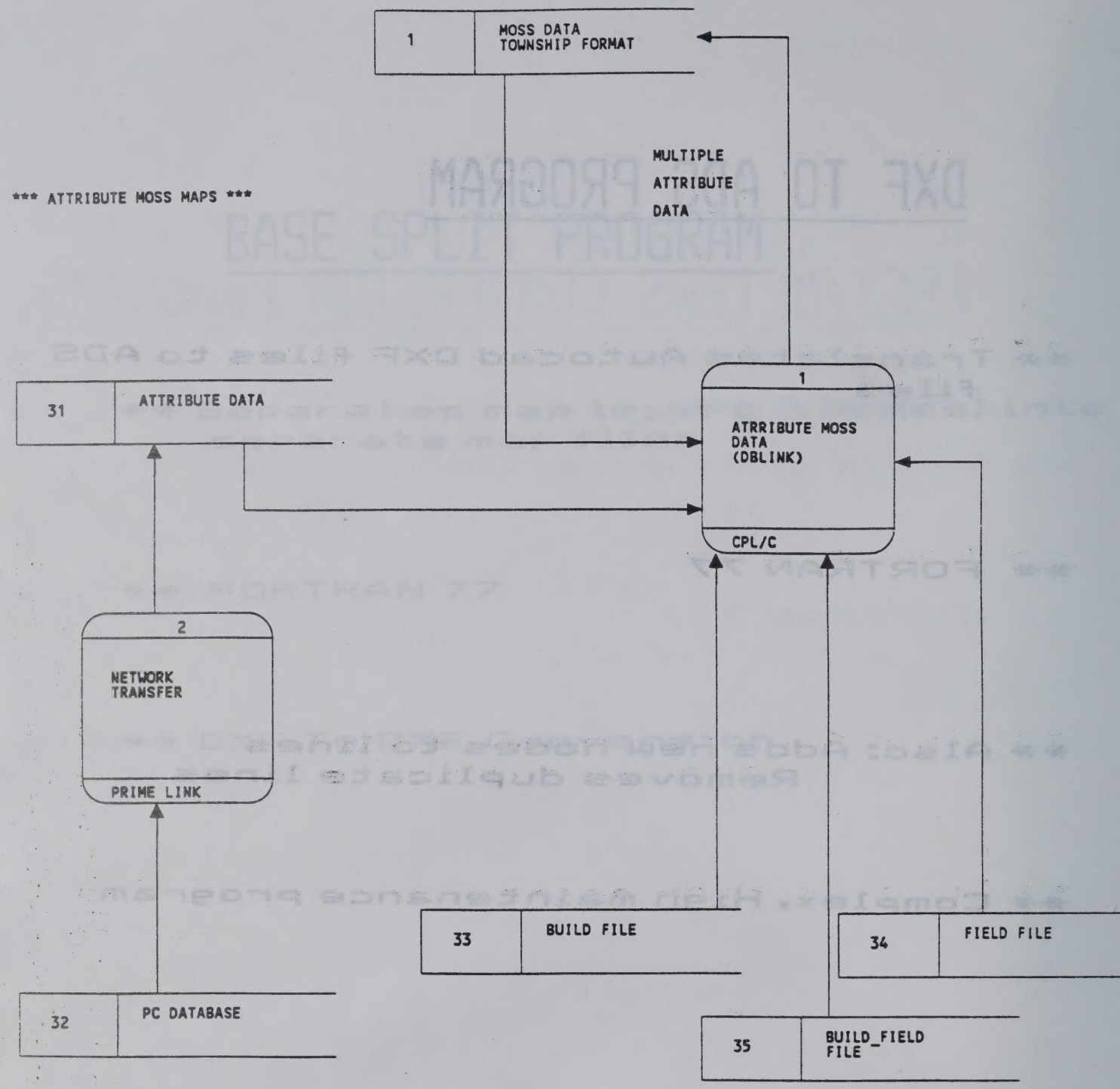
DXF TO ADS PROGRAM

** Translates Autocad DXF files to ADS files

** FORTRAN 77

** Also: Adds new nodes to lines
Removes duplicate lines

** Complex, High maintenance program

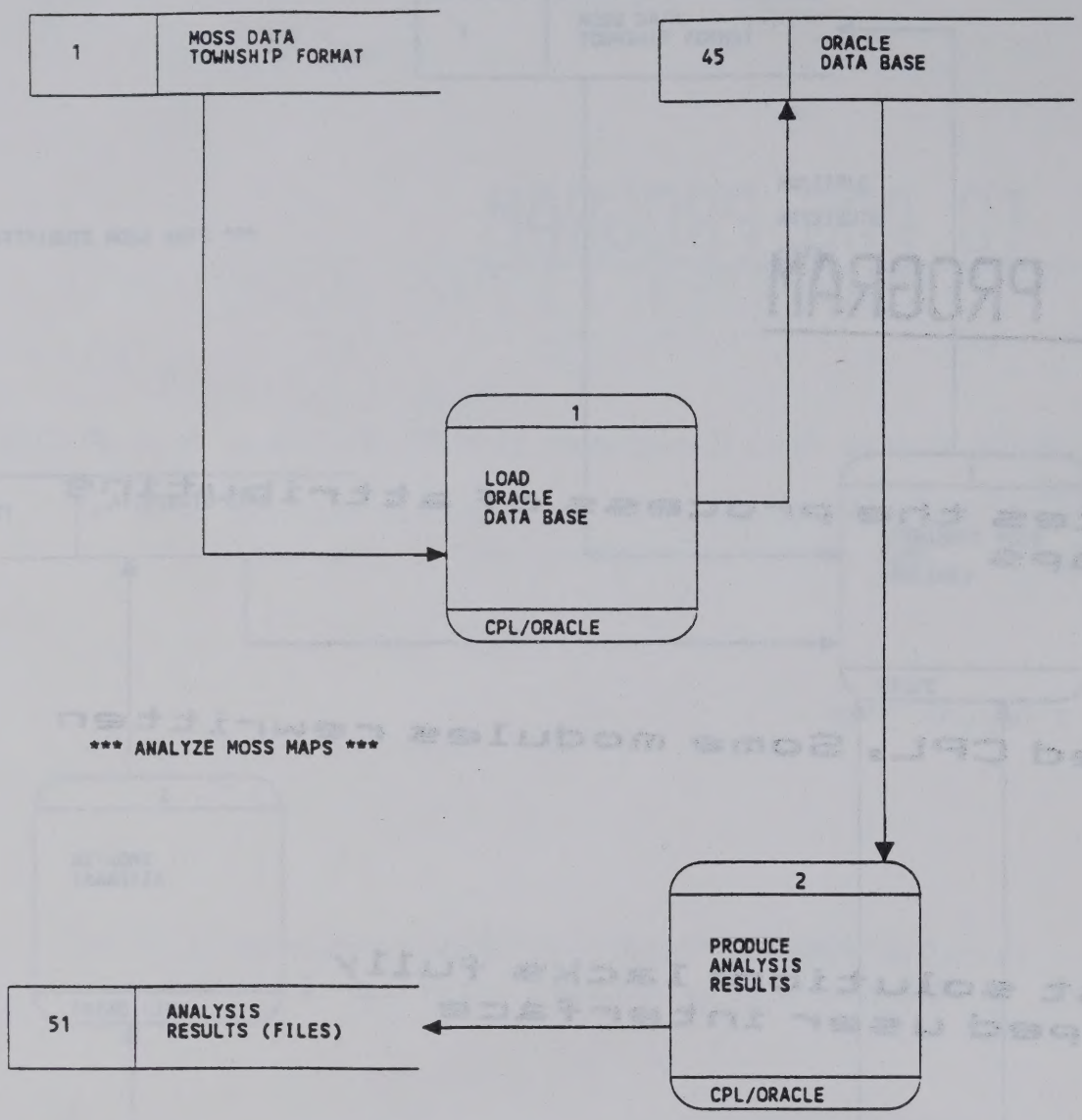

1
MOSS DATA
TOWNSHIP FORMAT
MULTIPLE
ATTRIBUTE
DATA
*** ATTRIBUTE MOSS MAPS ***
31
ATTRIBUTE DATA
1
ATRRIBUTE MOSS
DATA
(DBLINK)
CPL/C
2
NETWORK
TRANSFER
PRIME LINK
33
BUILD FILE
34
FIELD FILE
32
PC DATABASE
35
BUILD_FIELD
FILE

DBLINK PROGRAM

** Automates the process of attributing MOSS maps

** Compiled CPL, Some modules rewritten in C

** Low cost solution: lacks fully developed user interface


1
MOSS DATA
TOWNSHIP FORMAT
45
ORACLE
DATA BASE
1
LOAD
ORACLE
DATA BASE
CPL/ORACLE
*** ANALYZE MOSS MAPS ***
2
PRODUCE
ANALYSIS
RESULTS
CPL/ORACLE
51
ANALYSIS
RESULTS (FILES)

ORACLE/MOSS LINK PROGRAMS

** Stores MOSS produced data for analysis and delivery

** CPL/SQL

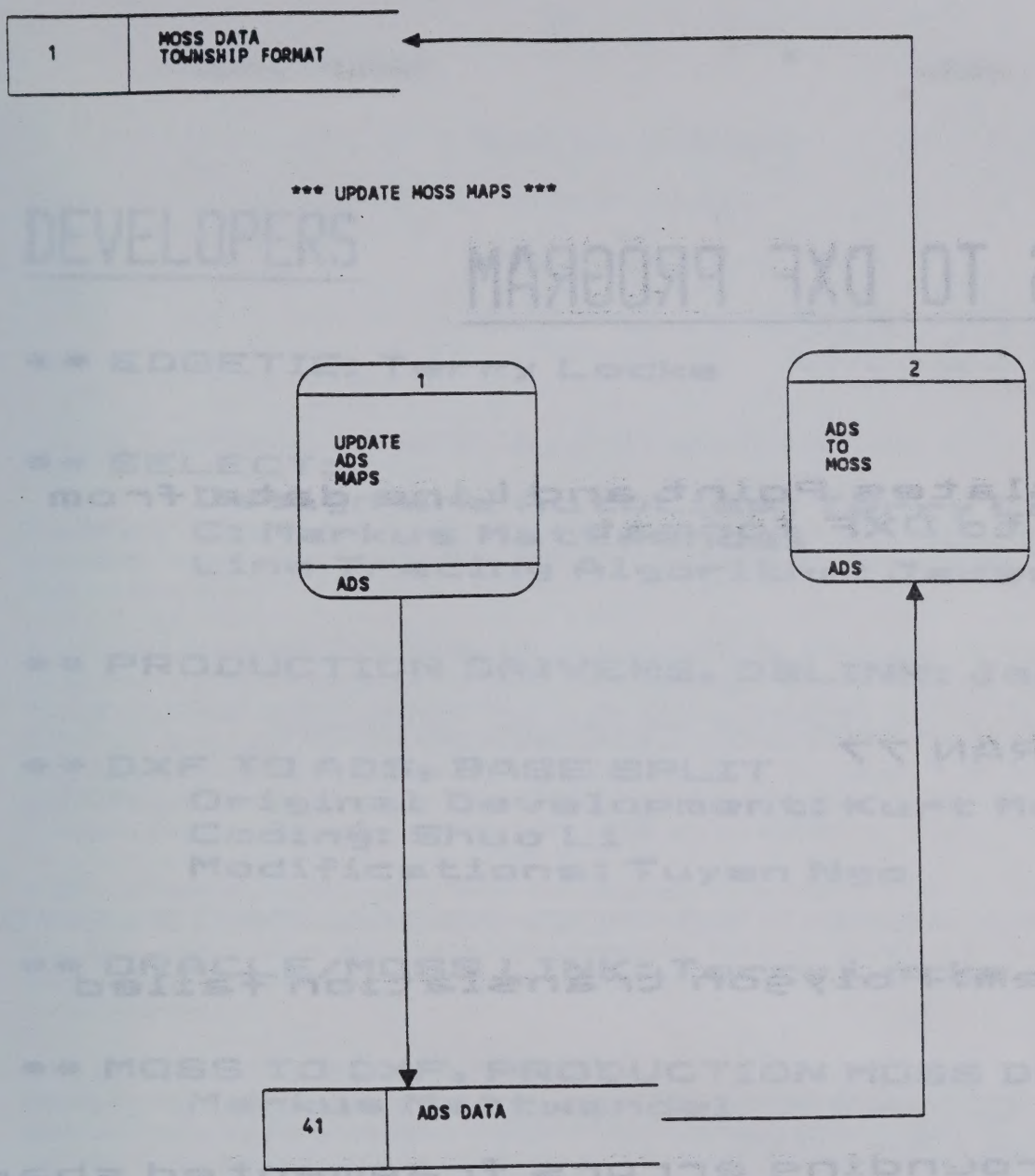
** Quality Control and Tracking of Processing

PRODUCTION MOSS DRIVERS

** Drives MOSS analytical processes

** CPL

** Handling of exceptional MOSS conditions: MOSS IF statement


1
MOSS DATA
TOWNSHIP FORMAT
*** UPDATE MOSS MAPS ***
1
UPDATE
ADS
MAPS
ADS
2
ADS
TO
MOSS
ADS
41
ADS DATA

MOSS TO DXF PROGRAM

** Translates Point and Line data from MOSS to DXF format

** FORTRAN 77

** Problem: Polygon translation failed

** MOSS rounding errors fragmented share polygon boundaries. Could not reconstruct correct map boundaries.

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CONCLUSIONS

** POWER OF CPL

** DIFFICULTIES OF TRANSLATION

** NEED TO ADAPT TO TECHNICAL PROBLEMS

** VALUE OF RELATIONAL DATA BASES IN SUPPORT OF GIS

TIMBER SALE SCHEDULING

PILOT GIS PROJECT
and
DATABASE PROTOTYPE

WINEMA NATIONAL FOREST
November 1990

Paper by Wanda Bennett, Assistant GIS Coordinator, Winema National Forest

The Winema National Forest is located in Southern Oregon on the east side of the Cascades. The Forest is 1,038,151 acres and was established in 1961 from adjacent National Forests and former Klamath Indian Reservation lands.

In June 1987, the Winema forest management team approved a GIS pilot project for timber sale scheduling on an area of approximately 470,000 acres of former Reservation lands on the Winema. It has become increasingly difficult to schedule timber sales on the Chiloquin and Chemult Ranger Districts due to past timber sale activity which, coupled with other activities such as precommercial thinning, are affecting the cover/forage ratios which in turn affect the mule deer population. The Klamath Tribe maintains hunting and fishing rights on the former Reservation lands and are concerned about a declining mule deer population. Therefore, they have filed appeals against many timber sales proposed for the area.

A GIS was seen as a tool to display timber sale areas spatially in relationship to the mule deer range rather than on a sale-by-sale basis as in the past. The initial use of the GIS was to map existing vegetation, past and current activities, and other resource constraints. The final product was to be a map showing areas available for harvest which meet all constraints, including cover/forage requirements, across all former tribal lands.

In conjunction with the pilot project and the Winema's desire to institute GIS on the Forest as a whole, an information needs assessment was begun in January 1988 with presentations to the forest management team and a three-day INA workshop conducted by Roger Tomlinson and the Region 6 INA Cadre. Participants identified 34 needed products and finalized the product descriptions between February and June 1988. The forest management team prioritized these products (the first three products identify data needs for the pilot project). The product descriptions identified the data layers needed, and a timeline was established for completion of each basic layer of data. The INA document was completed and approved by the forest management team in October 1988.

During this period, the Forest requested and received approval for the hardware and software necessary to operate MOSS. We ordered digital data (Cartographic Feature Files) from Geometronics Service Center in Salt Lake City and identified what timber stand information was needed for the pilot project in preparation for transferring stand information to mylar. The intent was to contract with GSC for the scanning of data.

In October 1988, we contracted with Autometric to provide MOSS user training for 6 participants. In addition, Chiloquin district began capturing a stand layer from current stand exam information.

In June 1989, we requested Regional Office assistance and funding to hire a private contractor to work with us on database design. Our intent was to produce a GIS database system and data linkage process that would be shared with and benefit all Forests in the Region. Some of our objectives were to explore techniques and options for linking various resource data tables to each other inside the database, get a better understanding of Oracle, and to explore linkages to outside databases such as TIS, STARS, TRI,

and local databases. The database was to be used initially for the pilot project and then expanded to cover the entire Forest as we made the transition to GIS. The Forest agreed to document the process in terms of problems encountered, successes, failures, and timelines needed to accomplish the various phases. The technical approval and financial assistance were approved August 22, 1989.

We met with, and received proposals for database design from, Vestra Inc of Redding, California, and Jet Propulsion Laboratory, associated with California Institute of Technology, in Pasadena, California. Due to the proposals and the funds available, the decision was made to go with Jet Propulsion Lab--JPL. JPL is under contract to NASA; and under the Economy Act, we were able to complete an interagency agreement with NASA for cost reimbursement. The Economy Act states that if one agency is doing a task and another agency has the same need, they can work off the existing contract. The negotiations were relatively simple--they charge us for what it costs them. It is what the Forest Service calls a "level of effort" contract. NASA calls it "best effort."

The JPL proposal was to study current Forest Service databases; review the proposed schema and data element dictionary; develop a tool for data conversion from existing databases into Oracle; develop a prototype Oracle database for installation on the Winema National Forest; provide training on how to build, install, formulate queries, and back up the database; and prepare a final report on the development and use of the prototype for full-scale implementation. The original proposal called for delivery two and one half months after the start of contract, contingent upon Winema's delivery of needed information.

The contract period actually began near the end of October, 1989, with a project completion date of February 28, 1990. JPL personnel Erich Corduan, Augie Rosas, and Ed Records met with Winema and Regional Office personnel in Klamath Falls on November 7-8, 1989, to discuss and collect information on the data model and data dependencies, and to start development of the prototype. They also received a briefing on how data is input to the system, how the MOSS polygons are created, indexed, and stored, how information from the database is to be displayed, and where the Forest Service intends to go with GIS.

On January 17-19, 1990, Erich Corduan and Augie Rosas met with Winema personnel to review requirements for the database prototype and to determine applicability of the Region 6 data standards. Due to the MOSS/Oracle link designed for MOSS (through the use of the mapitat table), it was determined that a new reference system would have to be developed to provide a constant for storing and retrieving information for extended periods of time. Several new or revised tasks were identified. JPL agreed to develop input screens based on current data input forms where possible and the Winema was to provide an updated data dictionary, a list of user classys for establishment of rights and capabilities for table and view accesses, copies of current input forms, reports, etc., and representative data in digital format. At that time, a contract extension to April 15, 1990, was agreed to.

So began the data dictionary project. Originally the contract with JPL was meant to build a database specifically for the pilot project--the first three products described in our Information Needs Assessment. But where do you cut off? As long as you are building a database for transportation, why not include all the transportation items you will need when you start expanding GIS to other uses? Since the Regional Office and Washington Office had published draft standards for many of the layers we needed, we tried to incorporate all those standards and attributes into our data dictionary. All three district GIS coordinators joined Leah Stewart, Information Management Specialist, and me in the development and production of a data dictionary over the period of about four weeks. Due to the time required for the Winema to produce the data dictionary and a high priority NASA project which redirected the work of Augie Rosas for a short period, JPL requested an additional contract extension period to July 1, 1990.

Leah and I travelled to Pasadena in June to review the vegetation portion of the database as built and to make recommendations for changes. Near the end of July, JPL spent one week on the Winema installing the Oracle database.

The prototype database was built with three partitions--vegetation, transportation, forest world, and forest dictionary. Vegetation includes all stand, layer, and species level vegetation information. Transportation is the road and road segment information. Forest world is what JPL called all other related information--i.e., hydrography, boundaries, landnet, land ownership, recreation, etc.

In order to uniquely identify each entry, JPL used a hidden machine-generated entry they call poly date stamp which is the oracle date down to one-tenth of a second. In an effort to track stand information over time, they have also built a history table which will hold certain stand information when a stand is updated. The product is a normalized database containing approximately 115 separate tables, excluding the dictionary. Forms were developed by JPL for Vegetation and Transportation, and more forms will be developed by the Forest for the other items. A menu system was created to facilitate use by the data administrator or the general user.

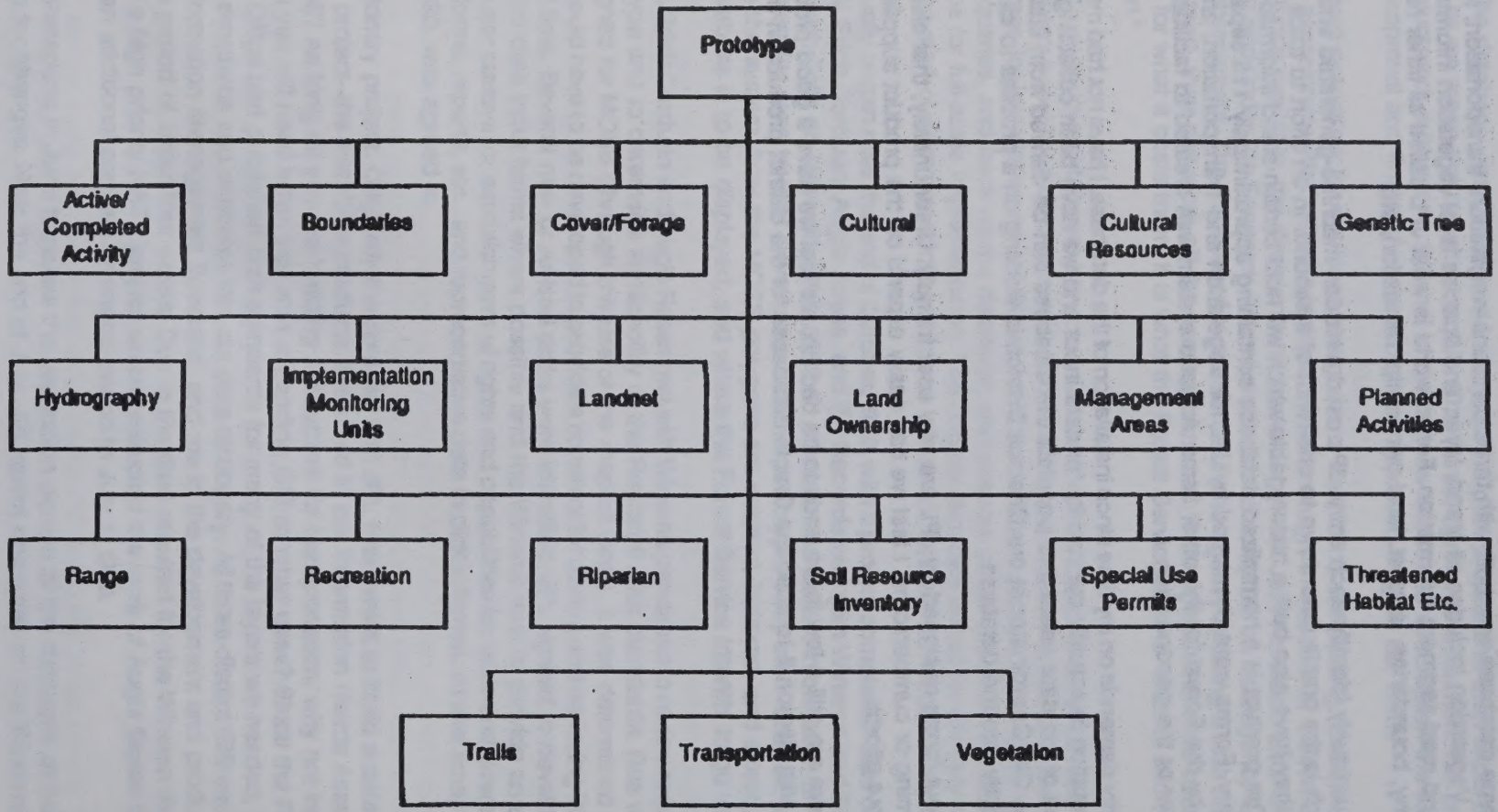
Due to priority demands on my time since installation of the database, I have not had much time to experiment with it. Vegetation is actually our priority for data input and we have been collecting that data. However, we feel most of the data needed to populate the database can be derived from stand exam output, and Andy Peavy, GIS Coordinator at our Chemult District, is working on a process to capture this data and insert it directly into the database.

The data input forms designed by JPL are very user friendly. Unfortunately, that also makes them a bit time-consuming or cumbersome. I feel we can easily expand on the product supplied by JPL to maximize our data input efforts.

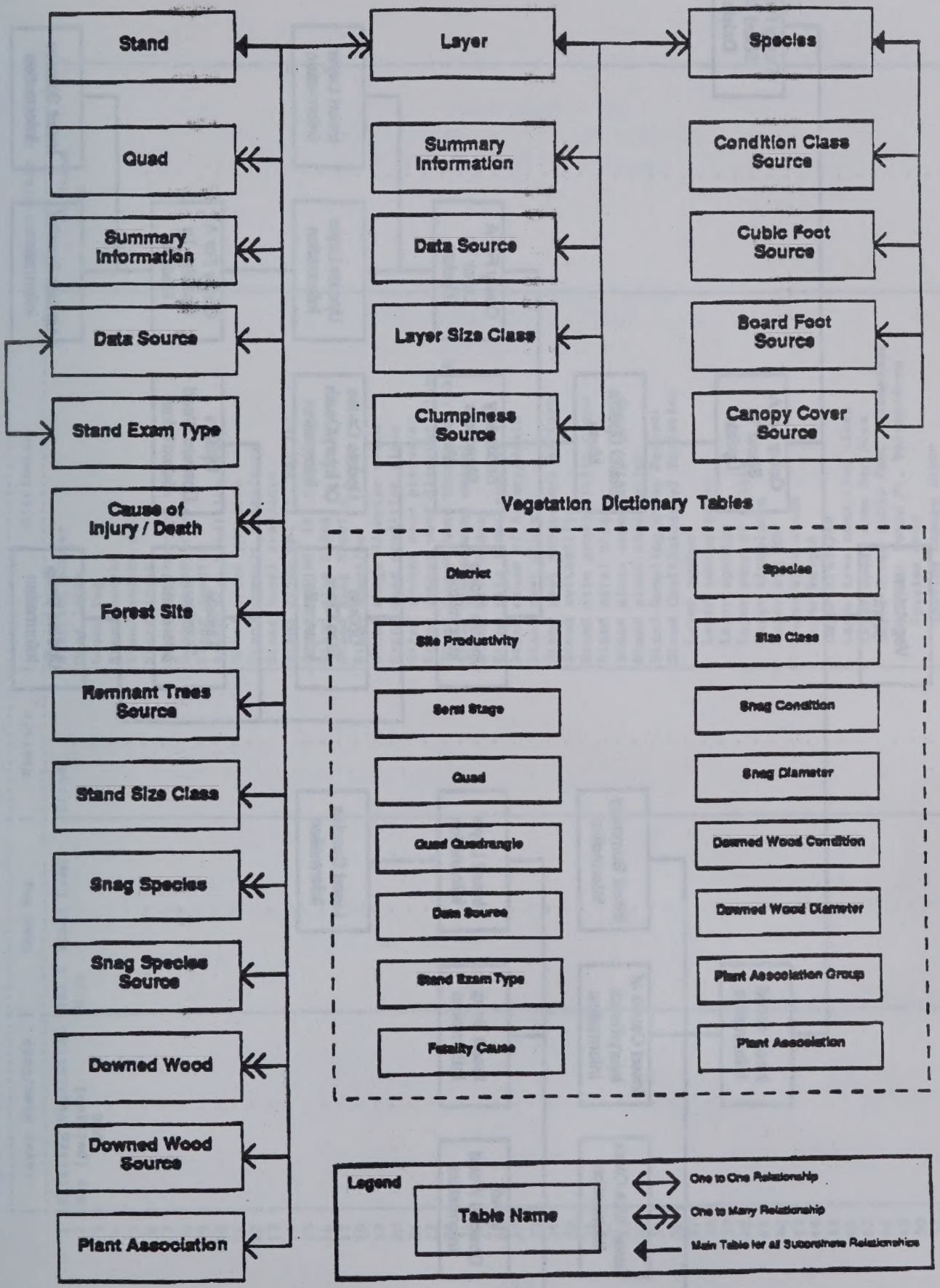
Although there are still a few loose ends to be tied up, we feel we have a good product. JPL is currently contracting with Region 6 to build the Oracle databases for the district production models.

WINEMA NATIONAL FOREST

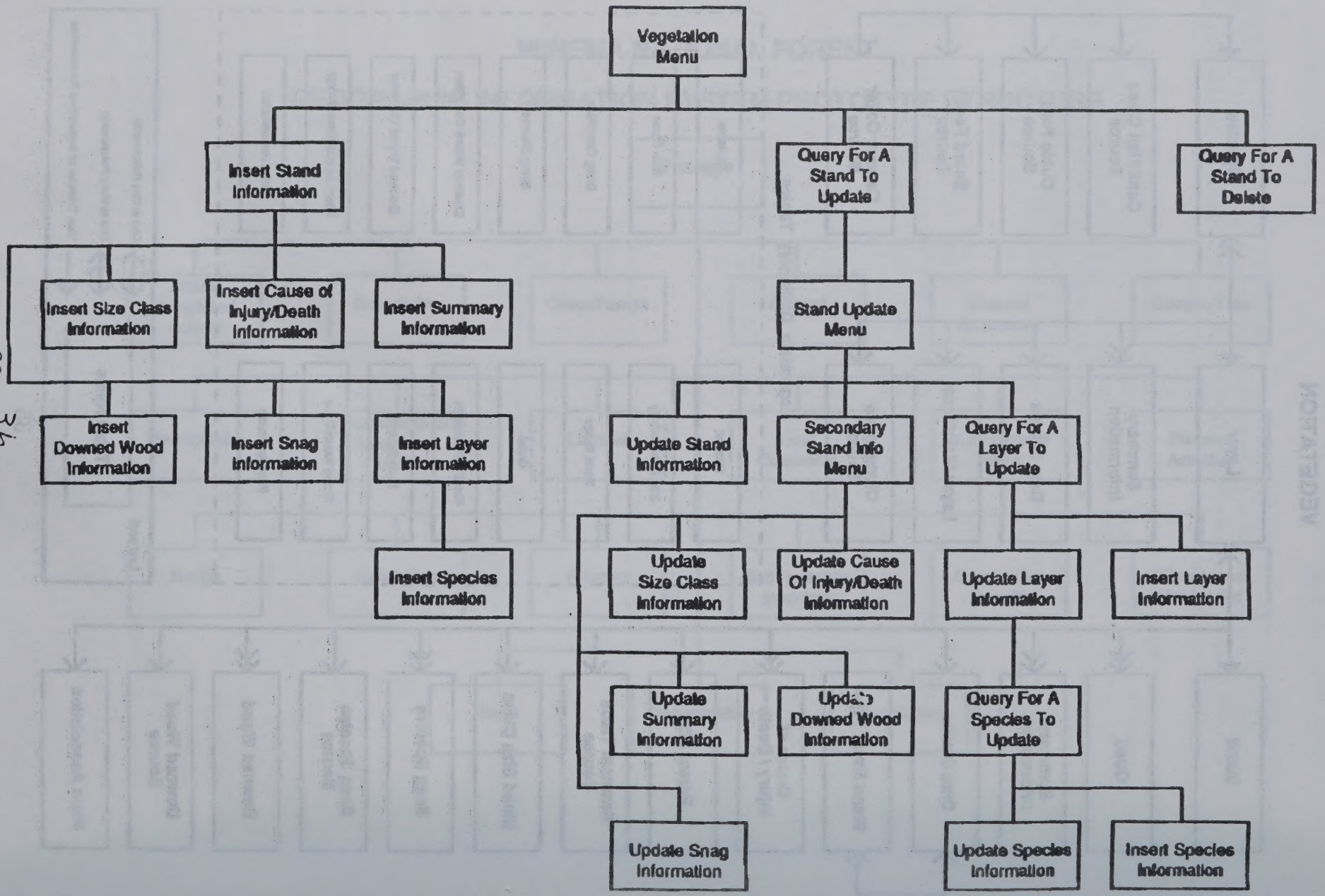
GEOGRAPHIC INFORMATION SYSTEM PROTOTYPE STRUCTURE



VEGETATION


Stand
Layer
Species
Quad
Summary Information
Condition Class Source
Summary Information
Data Source
Cubic Foot Source
Data Source
Layer Size Class
Board Foot Source
Stand Exam Type
Clumpiness Source
Canopy Cover Source
Cause of Injury / Death
Vegetation Dictionary Tables
Forest Site
District
Species
Remnant Trees Source
Site Productivity
Size Class
Stand Size Class
Seral Stage
Snag Condition
Snag Species
Quad
Snag Diameter
Snag Species Source
Quad Quadrangle
Downed Wood Condition
Downed Wood
Data Source
Downed Wood Diameter
Downed Wood Source
Stand Exam Type
Plant Association Group
Plant Association
Fatality Cause
Plant Association
Legend
Table Name
One to One Relationship
One to Many Relationship
Main Table for all Subordinate Relationships

VEGETATION FORMS STRUCTURE



Veg Attribute Table

	Layer Name/Code	Base Map	Feature	Attributes	Linkages-Other Databases
1	Existing Vegetation	TRI & Stand Exam	Stand	District number	R6 Stand
2	Map (polygon)	Maps	-	Quad Index	Exam
3	VEG		-	Stand tag	
4	-	-	-	Stand source	
5	-	-	-	Stand source date	
6	-	-	-	Stand Acres	-
7	-	-	-	Stand veg/non-veg code	-
8	-	-	-	Stand canopy cover	-
9	-	-	-	Stand species	-
10	-	-	-	Stand Tree Condition Class	-
11	-	-	-	Stand trees per acre	-
12	-	-	-	Stand remnant trees/acre	-
13	-	-	-	Stand basal area/acre	-
14	-	-	-	Stand gross cu. ft. vol./ac	-
15	-	-	-	Stand net bd. ft. vol./ac	-
16	-	-	-	Stand size class	-
17	-	-	-	Stand Snag Species	-
18	-	-	-	Stand snags/ac	-
19	-	-	-	Stand snags diameter class	-
20	-	-	-	Stand snag condition class	-
21	-	-	-	Stand downed wood pieces/ac	-
22	-	-	-	Stand downed wood diameter class	-
23	-	-	-	Stand downed wood condition class	-
24	-	-	-	Stand downed wood weight	-
25	-	-	-	Stand site index	-
26	-	-	-	Stand site index species	-
27	-	-	-	Stand cause of injury/death	-
28	-	-	-	Stand pest status	-
29	-	-	-	Stand pest management history	-
30	-	-	-	Stand suitability	-
31	-	-	-	Stand site productivity class	-
32	-	-	-	Stand seral stage	-
33	-	-	-	Stand plant association group	-
34	-	-	-	Stand plant association	-
35	-	-	-	Stand Sampling Error Percent	-
36	-	-	-	Stand Coefficient of Variation	-
37	-	-	-	Layer number	-
38	-	-	-	Layer canopy cover	-
39	-	-	-	Layer species	-
40	-	-	-	Layer year of origin	-
41	-	-	-	Layer clumpiness	-
42	-	-	-	Layer Avg DBH	-
43	-	-	-	Layer size class	-
44	-	-	-	Layer height	-
45	-	-	-	Layer trees/ac	-
46	-	-	-	Layer tree condition class	-
47	-	-	-	Layer Basal Area Per Acre	-
48	-	-	-	Layer Gross Cubic Feet Volume/Acre	-
49	-	-	-	Layer Net Board Ft. Volume/Acre	-
50	-	-	-	Species Code	-
51	-	-	-	Species canopy cover	-
52	-	-	-	Species trees/ac	-
53	-	-	-	Species Tree Condition Class	-
54	-	-	-	Species basal area/ac	-
55	-	-	-	Species diameter class	-
56	-	-	-	Species gross cu. ft. vol./ac	-
57	-	-	-	Species net bd. ft. vol./ac	-
58	-	-	-	Species height	-

Integration of the R-6 Transportation Information System (TIS) into the GIS environment

A Paper Presented to the
1990 MOSS User's Conference
Portland, Oregon

Ernie Bergan
GIS Coordinator
Ochoco National Forest
GIS/TIS/Roads Prototype Team Leader

Robert Varner
GIS Coordinator
Gifford Pinchot National Forest

November 1990

BACKGROUND

Two prototype efforts were initiated in the Oregon-Washington Region (R-6) of the U.S. Forest Service in June 1990 for which the goal was to integrate the current Transportation Information System (TIS) heirarchical database into a Forest GIS system. This Database is currently residing at the Fort Collins Computer Center (FCCC) in Fort Collins, Colorado on a Univac-S2K platform. Oracle will be used on a Data General platform as the database repository for the data.

The Ochoco National Forest in central Oregon and the Gifford Pinchot National Forest in southwest Washington volunteered to develop prototypes which could then be used as a guide for the remainder of the forests in R-6.

METHODOLOGY

The prototype effort on the Ochoco was developed using a 1:24000 7.5 minute quadrangle located on the Big Summit Ranger District. The Forest was so impressed with results on the prototype quad that the same structure is being implemented on the 9 quads impacted by the Burns Complex Fire in August 1990.

The Gifford Pinchot prototype was developed on the same base as the Ochoco, but utilized two adjacent quads located on the Randle Ranger District.

While the intent of both efforts was the same, a different approach was used on the two sites. Both prototypes utilized the required fields currently established in the TIS database and added several more which will enhance its ability to be used as a road and resource management tool. Both Forests also extensively depended on the use of the LTPlus software on a Xenix-based PC as a frontend processor for MOSS on the Data General.

On the Gifford Pinchot, TIS was ported in its current condition into Oracle. The digital transportation information was acquired from the Hewlett Packard 9020 Desktop Computer which has been used to digitize the location of the roads for the annual Forest Transporation System Update(TSU). This capitalizes on information that has already been digitized and is in pretty good shape. A link was then established by attaching a segment identifier consisting of the 7-character road number and the 4-character milepost at the beginning of each management section currently defined in TIS.

After porting to MOSS, macros provide the link to the Oracle database where a query can be performed calling on the segment_id which is then compared to the SPSS file for the map. This produces a list of items that can be SELECTed in MOSS with the FILE option.

The Ochoco prototype differs from the Gifford Pinchot prototype in that the TIS management sections are recompiled to break at every road junction, county line, and change in manage-

ment strategy. This provides the necesary link for transportation network analysis using shortest-path and least-cost algorithms. The Ochoco is also using the MOSS/Oracle link.

The following is a list of the fields in the two tables developed for this process in Oracle. The asterisks denote fields currently populated with data on the Ochoco. The pluses denote those currently populated on the Gifford Pinchot.

TIS_BASIC

+ Route number
+ Beginning M.P.
+ Route name
+ Length
+ Termini
+ Forest
+ Functional Class
+ State

TIS_COMBO

*+ Segment ID
*+ County
*+ District
*+ Jurisdiction
*+ System
*+ Development status
RTM ahead
RTM back
Alignment
Grade
+ Design vehicle
+ Design speed
+ Critical vehicle
+ Template
* Closure type
* Date open
* Date closed
* Reason closed
Traffic volume category
Special status
*+ Operational maintenance level
+ Objective maintenance level
+ Service life
*+ Traffic service level
*+ Primary maintainer

TIS_COMBO(cont)

Cost share area
Cost share cooperator
Haul season
Permits
Regulations
Pavement condition index
Date surfacing constructed
Pavement functional class
*+ Lanes
Width
*+ Surface type
*+ Management length

In addition to the above, two more tables have been designed. They incorporate data on the point features consisting of bridges and major culverts.

DISCUSSION

It took approximately 20 person days to develop a single quad of data with 584 segments using the Ochoco method, while it took 4 person days to develop 2 quads using the Gifford Pinchot approach. Simply put, the Ochoco prototype is what is needed over the long run, while the Gifford Pinchot prototype gives a short-term result that can evolve over time into the full-blown network system.

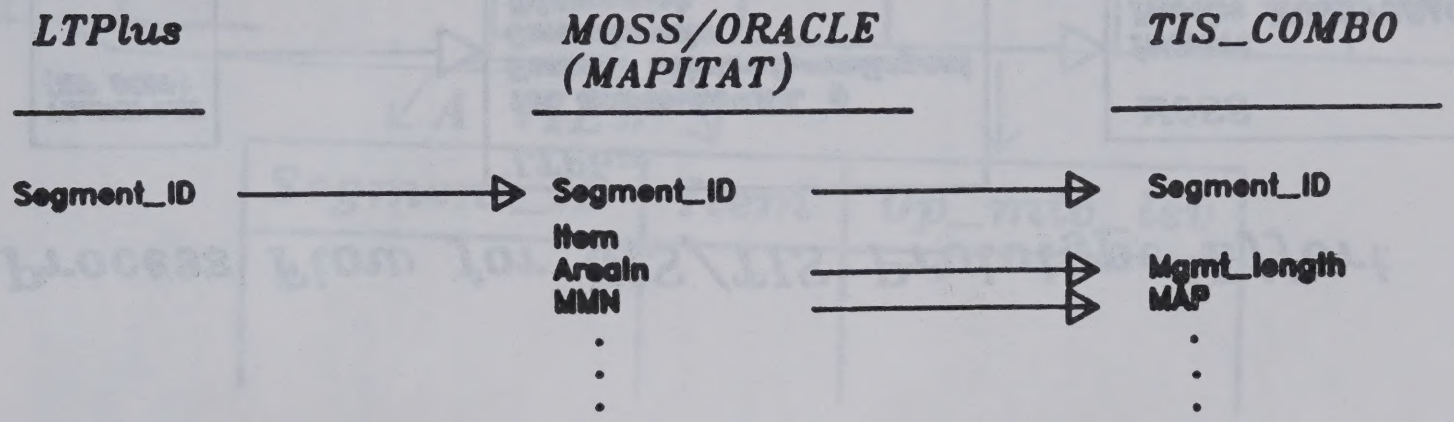
One of the first products developed on the Ochoco related to a road density question in a given area. This was calculated based upon an overlay of open roads and a set of polygons for a given alternative. The responsiveness of the results has impressed line officers and helped gain their support for the effort.

These prototypes have shown for the first time that geographical transporation information which is responsive to the need for quick analysis and display is an invaluable tool for road and resource management.

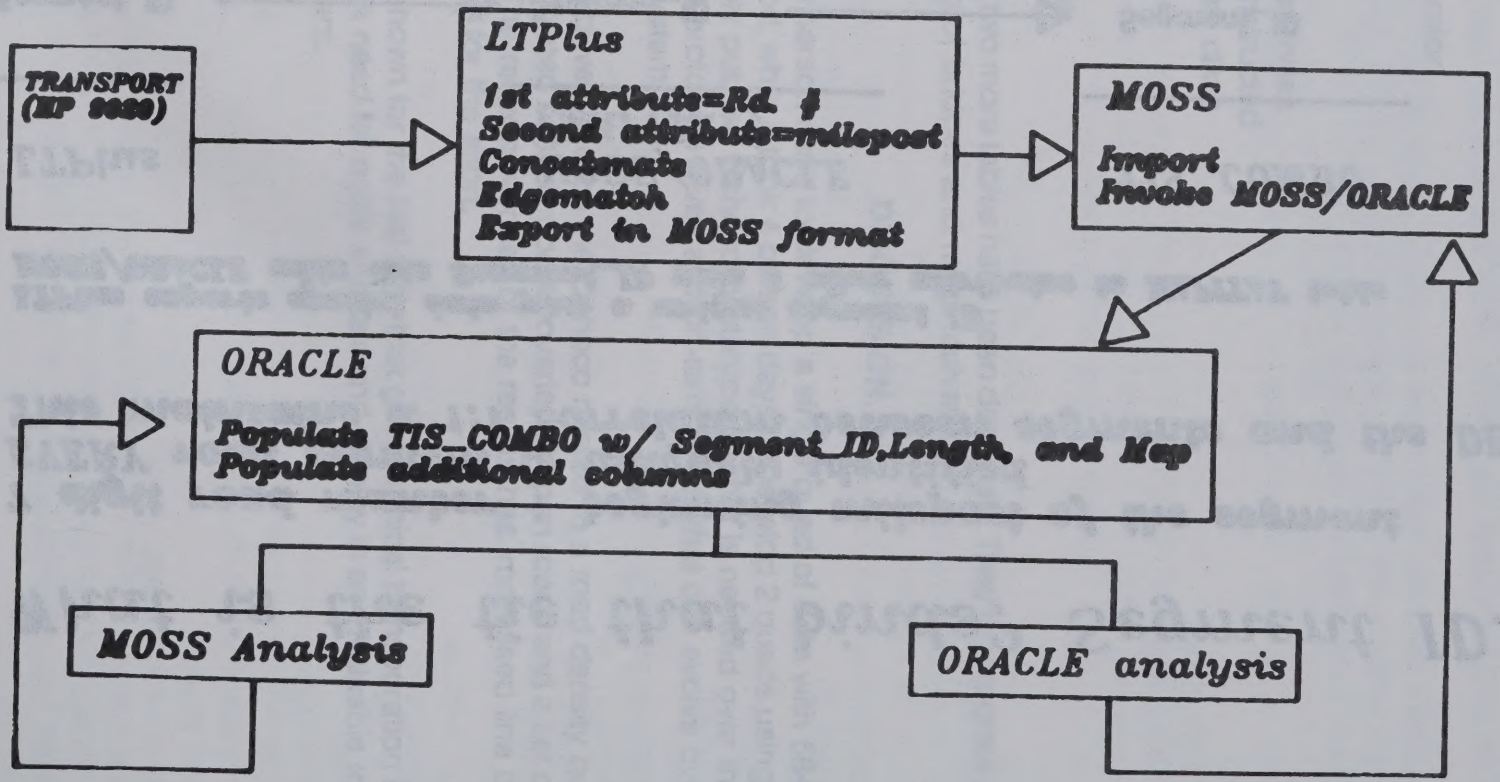
What is the tie that binds? Segment ID.

7 digit road number + beginning milepost of the segment
EVERY road segment is uniquely identified
This maintains a 1:1 correlation between segments and the DB

LTPlus exports spatial data plus a unique segment ID
MOSS/ORACLE adds this Segment_ID plus 6 other attributes to MAPITAT table

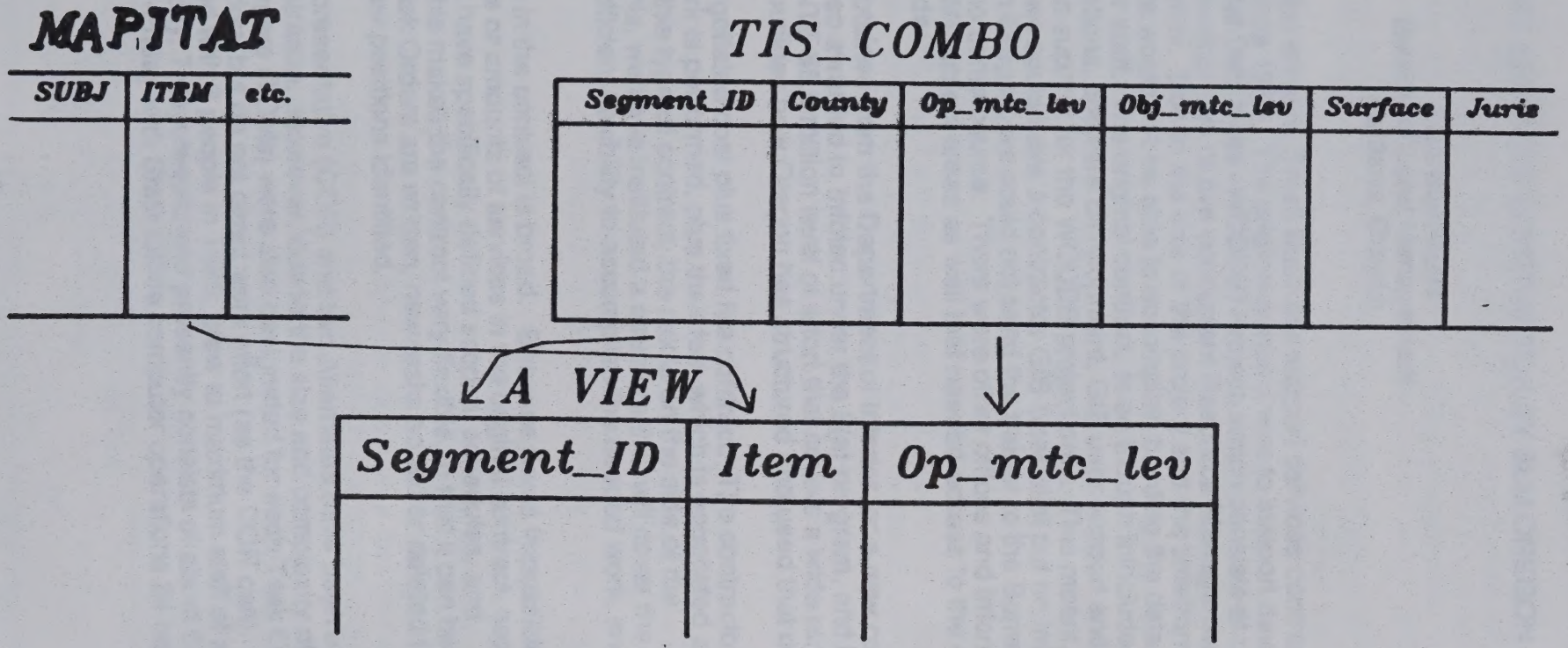


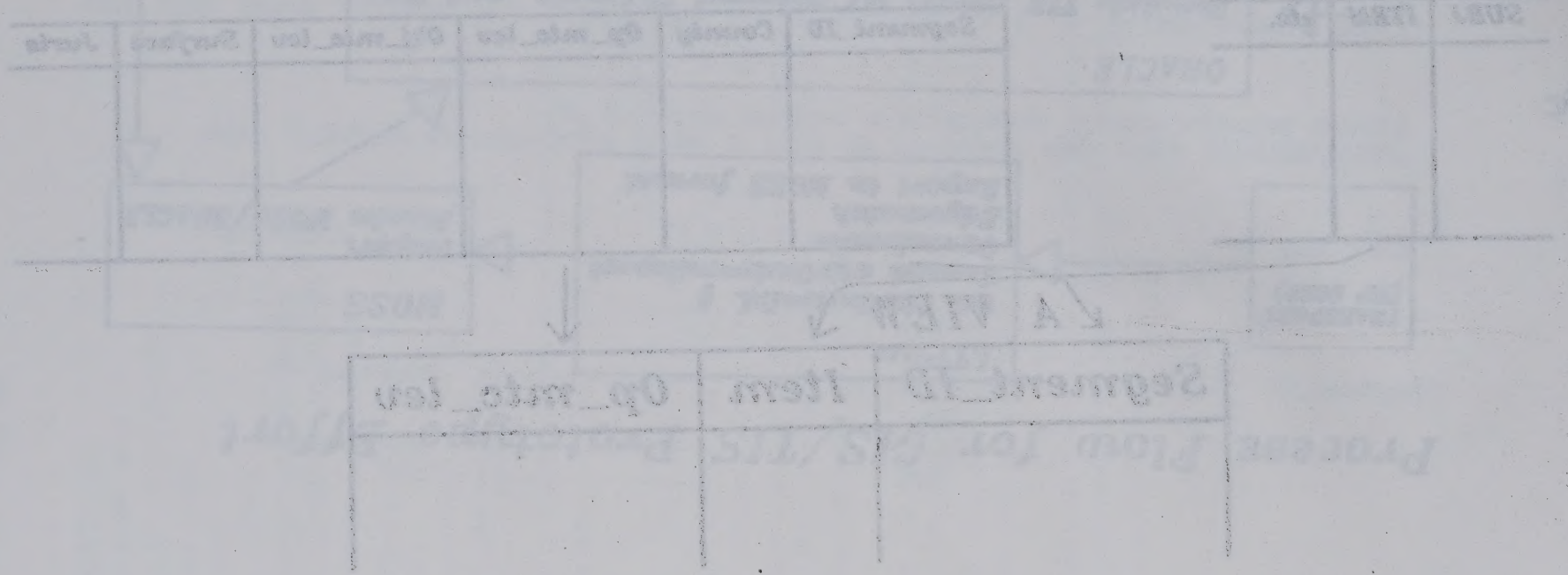
Process Flow for GIS/TIS Prototype Effort



Speeding up Queries.... VIEWS

VIEWS allow easy joining of tables without requiring the user to write complex queries. Views can consist of all or a subset of the columns of one or more tables.





USE OF A SUPPORT SERVICES CONTRACTOR BY BLM OREGON

Lisa Blackburn
Bureau of Land Management
Portland, Oregon

BLM Oregon has used an 8(a) minority Small Business support services contractor, Infotec Development Inc., since 1986. The original contract was to support development of the Western Oregon Digital Data Base (WODDB) Project, which consists of building a GIS data base to support development of five concurrent Resource Management Plans for the western Oregon districts. Due to the size of the project and the timeframes involved, we realized that we would not be able to accomplish building the data base without the use of contractor staff. The original contract, even though it included such activities as computer operations, software development, GIS user support and training, and data entry was limited to support for the WODDB project only. This meant, for example, that even though we could have a contractor GIS Specialist put on Introduction to MOSS training in western Oregon, we could not send the trainer to the Burns District in eastern Oregon to give the same course. There were other offices and Information Resource Management (IRM) subject areas as well that needed access to the contract to accomplish program needs.

As a result, approval was obtained from the Department of Interior for a new contract. The current contract was also awarded to Infotec under the 8(a) program, and began in FY 1989. It is a five year, NTE $8.5 million level of effort that covers a wide range of IRM activities. This paper outlines how Oregon has structured and used that contract.

The type of contract is a negotiated cost plus fixed fee contract. The contractor is paid for the number of hours work is performed, plus their fee, which is negotiated and established up front. With this type of contract, the risk is on the side of the government. Because of this, we have instituted a structure that will cover the required legalities as well as give sufficient flexibility to accomplish the needed work, and do it in a cost-effective manner.

The description of services in the contract is broad. Because it was impossible to determine the precise types or amounts of services in the original contract, separate task orders are issued that have specifically defined scopes, schedules, and deliverables as needed. This makes the contract very flexible, in that it can be easily modified whenever new Task Orders are written, new tasks added or deleted from existing Task Orders, or new positions identified.

A Contracting Officer's Representative (COR) and two Alternates have been established for overall contract administration. However, due to the size and complexity of our contract, Task Order Managers (TOMs) were also designated for each Task Order. TOMs give technical direction, but do not direct work effort (as the COR can). The contractor workforce started with 3 people in 1986; grew to maximum staff of about 140 in 1988 working 24 hours/day, 7 days/week; and presently consists of about 50 people working two shifts Monday-Friday with State Office computer operations 24 hours/day, 7 days/week.

Because of the developmental nature of work of most of the Task Orders, especially the WODDB-related ones, further direction for each Task Order is given through individual Instructions to Contractor (ITC). These are written on Form 1510-58 (see Figure 1 for an example of an actual ITC). The work requested must be within the scope of activities described in the Task Order. If it is not, then the Task Order must be modified first.

An ITC is issued if BLM must clarify tasks or directions, or outline additional duties. Examples include:

- authorize travel to perform an activity;
- document BLM requirements for a task (examples: conversion of lakes, wetlands and double-line streams to polygon; develop prototype data for ten year scenario team meeting);
- request a specific activity (examples: load 1:250,000 DTEM data to MAPS; move all Klamath Falls MOSS files from Medford Prime to State Office Prime; edit SYU theme);
- document a change in direction for an on-going activity (example: change CPL for second QC of roads and streams);
- document "standing instructions" to cover activities that will remain constant (example: perform data communications installation, monitoring, configuration and testing).

Because the ITCs are more specific than the Task Orders, technical direction from BLM is frequently needed. Since the TOM for a Task Order may not always be the BLM person who knows the technical information needed by Infotec for performing an ITC, a TOM is also designated for each ITC. This person may or may not be the TOM for the Task Order. By formally designating the ITC TOM, Infotec knows the BLM contact if clarification is needed, and the TOM can track work progress.

The ITCs are assigned a sequential number by the COR, and a log maintained for tracking. The Task Order number that the ITC applies to is also designated. The ITC log has been put into Lotus, and can be sorted a variety of ways including listing the ITCs by TOM; by Task Order; by Infotec staff assigned to; etc. The value of tracking the ITCs is to ensure that the work assigned is either accomplished, the due date changed if needed due to a shift in priorities, or canceled.

With a cost plus, nonpersonal service contract, we need insure that we do not cross the line into personal services type of contract, for which BLM does not have authority. With the developmental nature of the WODDB Project, the line between giving technical direction vs. the appearance of the government supervising contractor employees must be carefully monitored. The use of Task Order Managers and Instructions to Contractor has evolved into a workable method of providing instructions for work to be done and technical direction without being too cumbersome.

For further information, contact Lisa Blackburn at (503) 280-7276 or FTS 392-7276.

Form 1510-58
(December 1985)
(formerly 9100-1C)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NOTICE OF NONCOMPLIANCE/INSTRUCTION TO CONTRACTOR

Contractor or grantee	Contract or grant number
Infotec	OR952-CT9-1007
	Date: 6/14/90
Issuing Office	Instruction Number: 301 (T.O. # 8)

☐ Notice of Noncompliance: (Issued by PI or COR)

ADS Edit Evaluation

☐ Instruction to Contractor: (Issued by COR only)

Evaluate capabilities within ADS to move nodes in line data.

Provide alternatives for changing location of nodes while maintaining unique subject (MOSS) for each line segment.

TOM: Dan Wickwire

DD: July 13, 1990

(COR/PI)

CONTRACTOR'S ACKNOWLEDGMENT
WHEN DELIVERED IN PERSON

(Date)

(Signature of Recipient)

(Name and Title)

(Contractor's Name)

TO BE FILLED IN BY BLM REPRESENTATIVE
WHEN DELIVERED BY MAIL

This order received on the day of , 19

CO

EFFECTS OF LINEAGE ON SPATIAL DATA QUALITY. Brent Blair. Bureau of Land Management, Oregon State Office, P.O. Box 2965, Portland, Oregon 97208.

When the Spatial Data Transfer Standard is adopted as a Federal Information Processing Standard, a Quality Report containing sections on lineage, accuracy, logical consistency, and completeness will be required of agencies producing digital cartographic data. Using base theme data from the BLM's Western Oregon Digital Data Base, tests were conducted to determine the effects of the digital lineage portion of the GIS project on accuracy and logical consistency. Artificial cartographic objects in point, line, and polygon data structures were created to scale in State Plane Feet and translated from AutoCAD to ADS to MOSS, repeating the steps and using the hardware and software configuration employed in the GIS project. Three test sequences were performed: direct translation; digitized in ACAD and translated; digitized in ADS and translated. The coordinate pairs resulting from each test were compared to the originals for accuracy, logical consistency, and completeness. Results indicate that a high level of positional and attribute accuracy and logical consistency is maintained in the direct translation test. Completeness is negatively affected by "DXF2ADS" because this program does not generate identical coordinate pairs on both sides of the model boundaries causing breaks in lines when merged. Digitizing is the most significant source of poor data quality in all categories.

Copies of the paper available Spring 1991.

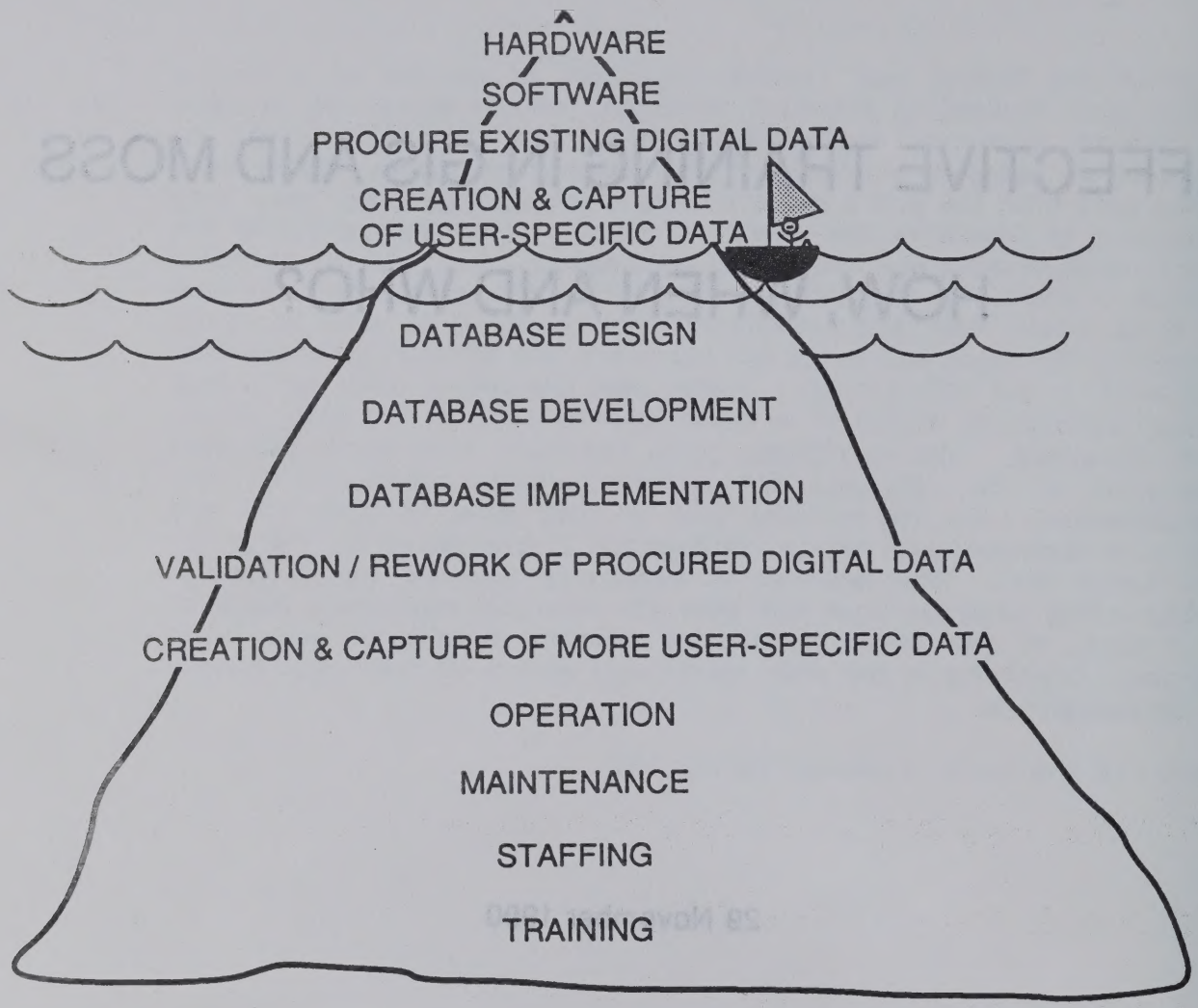
EFFECTIVE TRAINING IN GIS AND MOSS

HOW, WHEN AND WHO?

29 November 1990

Lisa Klapwyk-Crouser
Infotec Development, Inc.
Portland, Oregon 97232

THE COST OF GIS IMPLEMENTATION



The cost of implementing a GIS is like an iceberg. The obvious include the cost of hardware, software, the procurement of existing digital data, and the creation of capture of user-specific data. Database design, development, ..., staffing and training are not so obvious and begin to surface as implementation begins.

'IF THE COST OF THE HARDWARE AND SOFTWARE SCARES YOU, YOU BETTER GET THE HELL OUT.'

J. Stutheit, *Realty GIS-Really?*, (GIS WORLD, June/July 1990), p 24

Standard estimate for the preparation and maintenance of a spatial database is between 60-80% of most operating budgets (including the amortization of hardware and software costs)

But add in the results of a recent study which indicates that

Of the total cost of implementing a GIS, the cost of staffing can be twice as much as the cost of the hardware and software.

H.J. Dickinson and H.W. Calkins, *The Economic Evaluation of Implementing a GIS*, (International Journal of Geographic Information Systems, Volume 2, Number 4, October-December 1988), pp. 307-327.

With this sobering statistic in mind, effective training is vital to the success of a GIS implementation

TRAINING EFFECTIVELY IN GIS AND MOSS

- **COMMUNICATE THE RIGHT INFORMATION**

- **TO THE RIGHT PERSON**

- **AT THE RIGHT TIME**

All you have to do to train effectively in GIS and MOSS is communicate the right information to the right person at the right time.

Sounds Simple? As much as 80% of the data managed by government agencies have a spatial context. A tool like GIS has applications in many disciplines, from urban planning and natural resource management to military and emergency response. As a result the "right" audience is a huge mix of skills and needs

The following is a quick overview of a very complex subject. The design, development, and implementation of any successful training program is well thought out. Kay Tytler Abella and Julia Sandquist list six critical questions that must be answered before begininning:

OVERVIEW OF THE STRUCTURED DEVELOPMENT OF A TRAINING PROGRAM

Six critical questions that must be answered before beginning:

1. **Should a Needs Analysis be done?**
2. **What information do I need to design the program?**
3. **What are the best resources available for the information?**
4. **What is the best way to get the information needed from the sources?**
5. **How will I compile, analyze, or summarize the information?**
6. **How and to whom will I give the information?**

1. Should a Needs Analysis be done?

Absolutely

- A Needs Analysis is used to identify the best solution for bridging the gap between present job performance and desired job performance.

2. What information do I need to design the program?

- Who are the users
- What is their job
- What are their data requirements
- How do they intend to use GIS
  - What tasks are critical
  - What tasks are supplemental

3. What are the best resources available for the information?

- Existing Users
- Potential Users
- Application Specialists
- Support Staff
- User Support Records (Hotline) — *Identifies weak areas*
- Course Evaluations — *Identifies weak areas*
- Academic and Research Institutions — *may present an application in a more effective way*
- Training Programs from a variety of vendors — *may present an application in a more effective way*

4. What is the best way to get the information needed from the sources?
    - Question
    - Observe !!!!
    - Evaluate

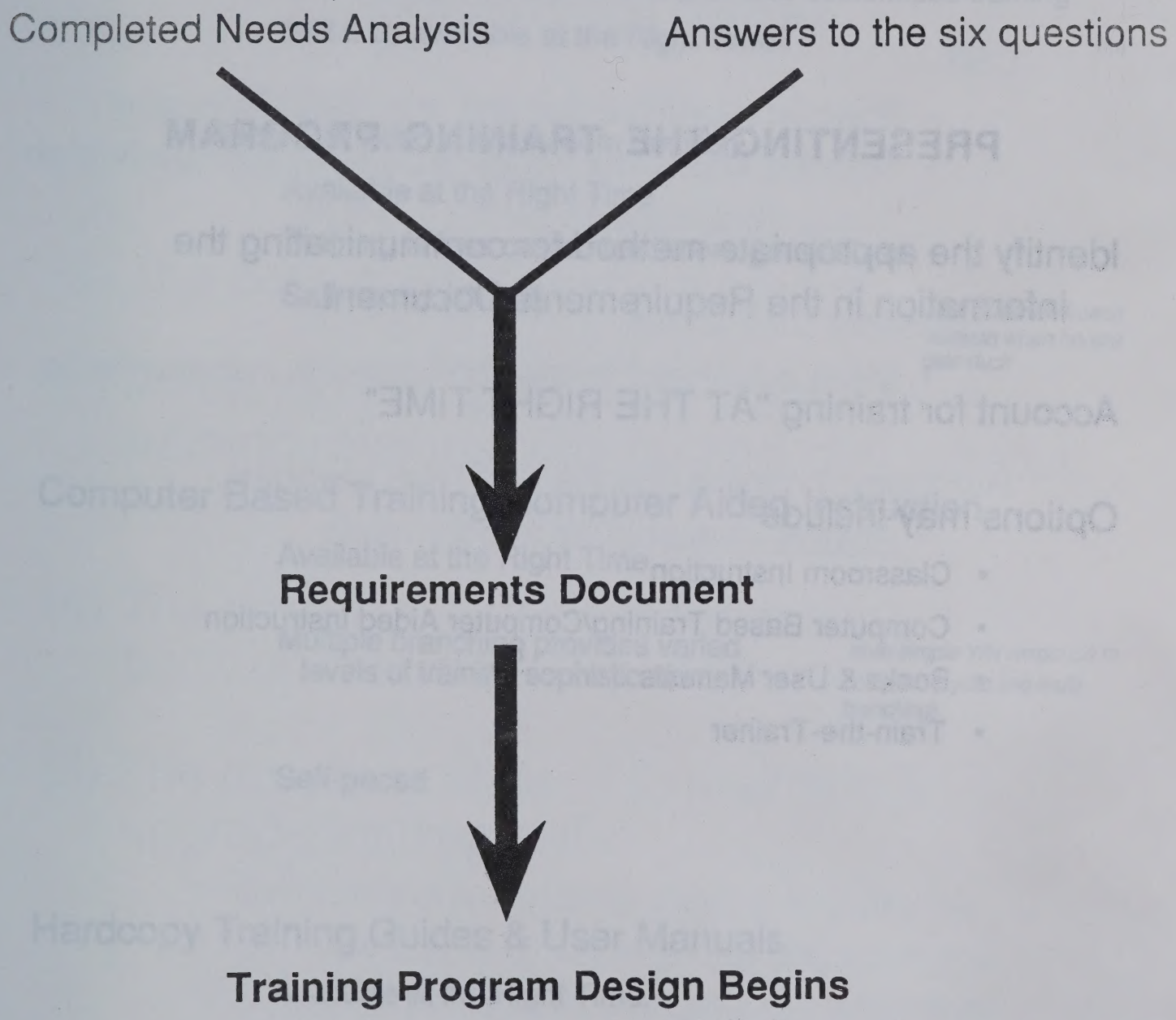
5. How will I compile, analyze, or summarize the information?
    - Varies

        Training needs matrices are a good first step

        x axis = job titles
        y axis = job tasks

6. How and to whom will I give the information?
    - Summary report to the sponsors
    - Findings should be made available to other key staff personnel e.g. User Support Representatives, Documentation Specialists, Product Designers.

Once these questions are answered and a Needs Analysis completed, the information is compiled into a requirements document. The design of the training program then addresses each requirement identified in the requirements document.



These steps should clarify the requirements of a successful training program including

- *Multiple training paths (unique training goals for managers, technicians, users) and*
- *Multi-stage cirriculum (from introduction through advanced courses capable of being presented as individual modules).*

Now that the information and student have been identified, the next step is identifying the appropriate method for communicating this information. It is at this point the training program accounts for presenting "AT THE RIGHT TIME."

PRESENTING THE TRAINING PROGRAM

Identify the appropriate method for communicating the information in the Requirements Document.

Account for training "AT THE RIGHT TIME"

Options may include

- Classroom Instruction
- Computer Based Training/Computer Aided Instruction
- Books & User Manuals
- Train-the-Trainer

Classroom Instruction

- Traditional and Televideo

  Low Student : Teacher ratio provides customized training

  Will it be available at the Right Time? !!!!!

- Recorded Video of Classroom Session

  Available at the Right Time

  Training is less customized/more generalized.

  Self-paced (Quasi)

  But student will need support when he/she gets stuck

Computer Based Training/Computer Aided Instruction

Available at the Right Time.

Multiple branching provides varied levels of training sophistication

from simple Y/N response to complex (cyclic and multi-branching)

Self-paced

Hardcopy Training Guides & User Manuals

Available at the Right Time.

Varied level of sophistication

Self-paced

Will users really use the manuals as a stand-alone training method

Use the above methods as Compliments

CBT

- Specific repetitive training e.g. GIS Concepts
- Training situations where staff turnover rate is high
  e.g. data capture (ADS, LTPlus)

Classroom Instruction

- More advanced application specific requirements

Hardcopy Training Guides and User manuals

- Always available as supplements

Train-the-trainer method is currently popular and is an excellent way to develop strength within your D.O.or N.F. It can be a great asset providing the following criteria are met

Train-the-Trainer

(1) The person knows GIS

(2) The person wants to be a trainer

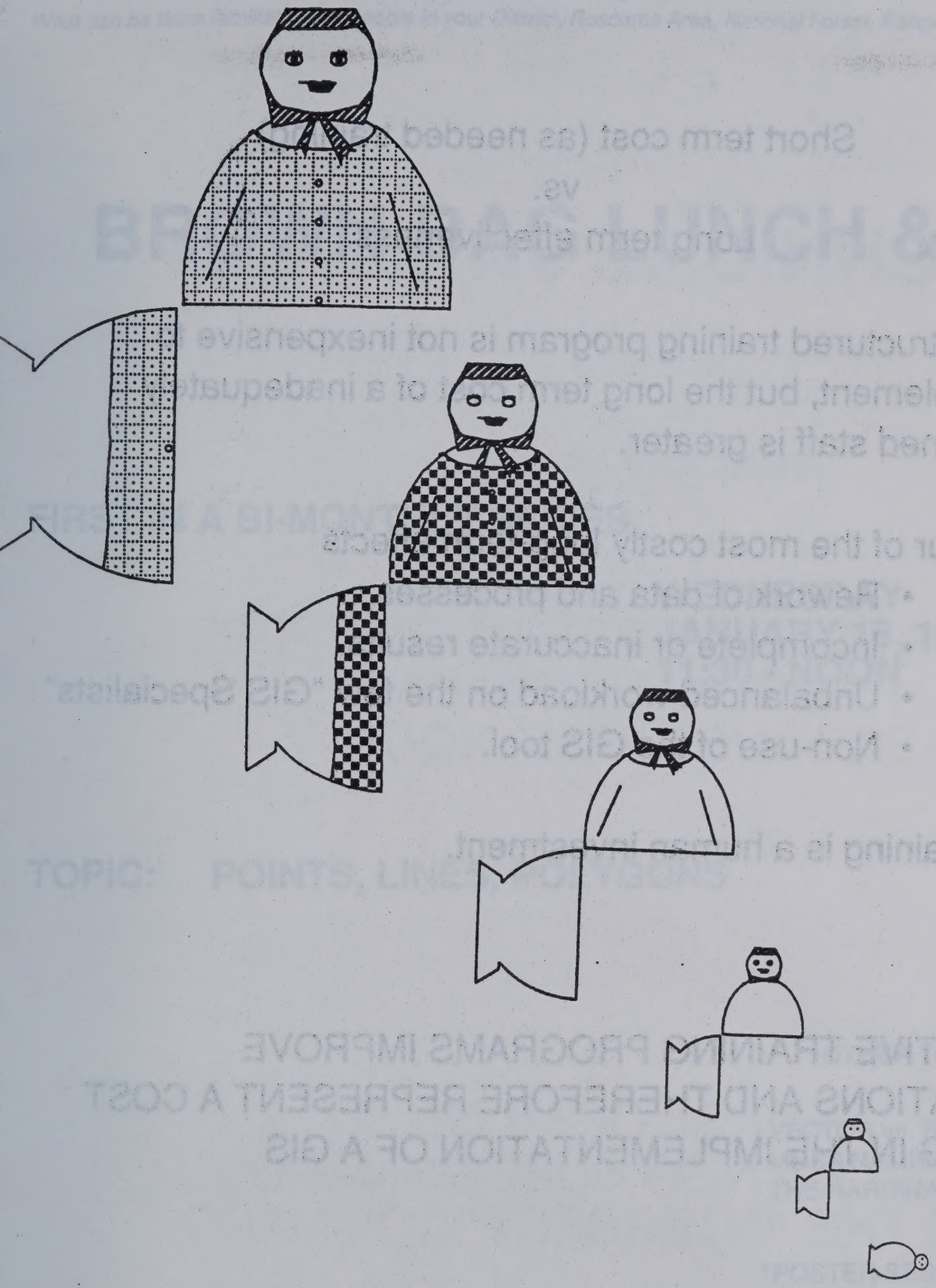
(3) Management recognizes the person's training responsibility and accommodates it in their work schedule

(4) The person is given proper training back-up materials (courseware)

(5) The person is allowed to maintain & upgrade training skills

- Seminars emphasizing training techniques
- Seminars/training to keep GIS skills current
- Forum for sharing this information with other train-the-trainers in other field offices

Without this criteria this trainer will train someone as time allows, who will train someone as time allows, who will train someone as time allows...until the effect becomes something like this:



The Effectiveness of Training can diminish if the Trainer is not given adequate support materials and time.

Short term cost (as needed training)

vs.

Long term effectiveness

A structured training program is not inexpensive to implement, but the long term cost of a inadequately trained staff is greater.

Four of the most costly long-term effects

- Rework of data and processes
- Incomplete or inaccurate results
- Unbalanced workload on the few "GIS Specialists"
- Non-use of the GIS tool.

Training is a human investment.

EFFECTIVE TRAINING PROGRAMS IMPROVE OPERATIONS AND THEREFORE REPRESENT A COST SAVING IN THE IMPLEMENTATION OF A GIS

BROWN BAG LUNCH & GIS

FIRST IN A BI-MONTHLY SERIES

WEDNESDAY
JANUARY 16, 1991
11:30 - NOON

TOPIC: POINTS, LINES, POLYGONS

OTHER TOPICS:

VECTOR vs. RASTER
MOSS NAMING CONVENTION
THE HARDWARE COMPONENTS

*POSTER SESSION OF
RECENTLY COMPLETED
PROJECT

TECHNICAL SATURDAY

FEBRUARY 10, 1991

GIS SPECIALIST WILL BE THERE TO PROVIDE TECHNICAL ASSISTANCE 9AM - NOON

NEW RELEASE OF MOSS INCLUDES NEW SUBCOMMANDS FOR THE "INTERSECT" COMMAND

The session is not structured. It is an opportunity for users to be purely technical and have a specialist available for assistance. If new exercises were released with the version it would provide an excellent opportunity to update skills

What can be done familiarize the people in your District, Resource Area, National Forest, Ranger District with your work

BROWN BAG LUNCH & GIS

FIRST IN A BI-MONTHLY SERIES

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Line Trace Plus
A Federal Success Story

by John Dabritz and Holly Martin
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P.O. Box 3623
Portland, Oregon 97208

The Forest Service, Region 6, Engineering, Geometronics faces the challenge of providing and supporting the guidelines and technology for the collection of digital data for GIS. One of the most powerful tools available is **Line Trace Plus (LTPlus)**. The Region actively supports a strategy for implementation and support of this application. The power of a Geographic Information System (GIS) is unquestionable. The value of its output is directly dependent upon the integrity of the data input; "garbage in, garbage out." Bad data, or data collected inefficiently, can have perilous, long-term affects upon the entire GIS process. Any technology which can reduce the risk of data degradation while facilitating the collection of massive amounts of digital data will be instantly embraced by those groups of people tasked with supplying information to a GIS. **LTPlus** has become the tool of choice in this effort. The Forest Service and the Soil Conservation Service have jointly developed this application which is rapidly acquiring a customer base which includes users from other agencies, from universities and from the private sector. Surviving the perils of life on the bleeding edge, **LTPlus** is a Federal success story.

What is LTPlus?

LTPlus is a universal data collection tool capable of accepting and processing both raster and vector input from a variety of sources. Once in **LTPlus**, raw digital data may be edited, merged with other layers of digital data, edgematched, attributed, plotted and output in a number of formats in preparation for input to a GIS. **LTPlus** accepts manually digitized data, raster scan data, and either raster or vector data imported from another application.

What is the Line Trace Project?

Jointly sponsored by the Forest Service and the Soil Conservation Service (SCS), the Line Trace Project was implemented to replace the current, obsolete Line Trace system at the FS Geometronics Service Center, and to provide SCS with a graphics data collection 'front-end' for that agency's GIS, GRASS. The Line Trace Development Team designed an application, called **LTPlus**, to meet both of those needs. The process, initiated in January, 1988, required the migration and adaptation of the functionality of its predecessor, the Local Interactive Digitizing and Editing System (LIDES), a Forest Service application which resided on a Hewlett Packard 9020B system, to 386 PC architecture in the C language, in a UNIX operating system environment.

LTPlus vs LIDES?

In nature, **LTPlus** is very similar to the LIDES application. However, unlike LIDES, this new application operates under UNIX on a PC-type workstation, and does so at up to ten times the speed of the HP LIDES package. **LTPlus** also incorporates functions for performing contour digitizing, a requirement for its role as

the replacement for the Line Trace application currently used by the Geometronics Service Center (GSC) in Salt Lake City.

Multi-Agency Involvement

SCS funded a major portion of the **LTPlus** development effort as that agency had determined that **LTPlus** would serve as the front-end data collector for its GIS, GRASS, which also operates under UNIX on an AT&T 6386 workstation. In conjunction with SCS, the Forest Service is currently writing an Operations and Maintenance document which will clearly define roles and responsibilities regarding the future program and training support required for **LTPlus**. As predicted, the **LTPlus** package has been embraced by a number of other agencies, including BLM, USGS and miscellaneous State groups.

How Is LTPlus Impacting the Region?

LTPlus is impacting the Pacific Northwest Region in a very positive manner. The Region is experiencing a critical need for data which can be analysed by a GIS to produce answers to questions posed by an environmentally astute public. **LTPlus** is simply one tool for responding to this growing need. It predecessor, LIDES, has been a key factor in almost every resource analysis project to date. **LTPlus** is simply an outgrowth of that application, providing a more powerful system which exists on a more universally acceptable platform than its predecessor.

What Is the Field Response to LTPlus?

In Region 6, it appears that **LTPlus** will be a widely-used product. It has been officially confirmed as the primary data collection package for interim GIS activities. Region 6 has been given interim authority to use the MOSS GIS. Unfortunately, the front-end digitizing portion of MOSS, AMS (or ADS), is both unwieldy and restrictive in nature. Of those two characteristics, the most dismal and limiting is that application's inherent reliance upon manual digitizing of resource data. MOSS has limited capability for accepting raster scan information. Consequently, field users are eagerly embracing its successor, **LTPlus**, which allows input from scanners, manual digitizing and from vector or raster formats generated by other applications.

The affect on the field is best represented by the overwhelmingly positive response to an informal survey attempting to determine the number of potential **LTPlus** sites. Feedback from 16 Forests indicated a desire for procuring more than 50 new hardware systems in FY90. In addition, several units advised that systems justified for other purposes were being configured with **LTPlus** usage in mind. In reality, a recent survey suggests that there are more than 100 active **LTPlus** sites operational in Region 6.

How Has LTPlus Hardware Been Procured?

During the first six months of FY90, Geometronics worked closely with both the information management and contracting staffs of the Regional Office to develop an efficient procurement process. A team of **LTPlus** specialists developed contract specifications and evaluated the submitted proposals. That contract was awarded in June to International Data Products for delivery of Everex 386 systems. Each ordering unit configured its purchase(s) from a line item list supplied by the contractor. The "average" **LTPlus** system is comprised of an Everex Step 386/25 with 12Mb of RAM, a 338Mb hard disk, both 5.25" and 3.5" floppy disk drives, a Mountain Series 7000 1/4" cartridge tape drive, a Packard Bell VGA monitor, Panasonic wide-carriage, 24-pin printer, a Hostess 4-port async adapter and a Logitec serial mouse. Each system is delivered

with both SCO Xenix 2.3.2 and DOS 3.3 installed. It is expected that the contract will be extended into FY91 for purchase of an additional 20-30 systems.

Scanning For LTPLus

Several sites within the Region have purchased scanners for use with **LTPlus**. The models acquired include the Houston Instruments ScanCad system, the IDEAL Scanner and the Houston Instruments LDS4000 E-size scanner device. The latter two are capable of scanning a quad size manuscript in less than a 30 seconds, generating a raster file which is easily imported into **LTPlus** for processing.

LTPlus Operation and Maintenance

While the Operations and Maintenance document being written by SCS and the Forest Service will address **LTPlus** activities with regard to multi-agency involvement, it will not attempt to define specific roles and responsibilities which are agency-dependent. It is fairly evident at this time that each Region will be responsible for providing training support to field offices with regard to **LTPlus** usage. In addition, the Regional Offices will likely provide supplemental data input/processing support for projects with critical timeframes. After several years of experience with training support for LIDES, Region 6 is fully prepared to train members of the RO, Geometronics staff to provide technical and production support. It is also necessary to develop a strategy for providing a comprehensive training and implementation plan within the Region. It is not enough to simply supply a User's Guide for an application like **LTPlus**. It is crucial to understand that **LTPlus** is a tool used within a very complex process. It is the process which we must be prepared to explain and support.

Training for GIS Activities (including LTPlus)

The Region 6, Geometronics Group has been asked to provide at least two different courses with regard to Regional GIS activities. In response, two new courses appear in the Engineering course catalog. "Cartographic Principles for GIS" attempts to provide field users with a comprehensive knowledge of cartographic techniques and skills as they relate to preparing data for input to a GIS and for generating useable maps from the GIS environment.

Training for **LTPlus** was initially offered as a joint SCS-FS [ad]venture. SCS provided the training facility, including the hardware, and the FS provided the instructors. The SCS facility, located in Ft. Worth, Texas, was the site of four, week-long sessions. Class size was limited to 16 students per session (2 per machine). Six **LTPlus** training sessions have been provided within Region 6 during the last five months, accomodating approximately 120 people. Two more are planned, one in December and one in January. These classes are requested and coordinated by host Forests and are generally limited to 20 students per session. The attendees must provide the hardware, one system per two trainees.

How Will the Geometronics Staff Be Impacted?

Region 6 is at the leading edge of this technology for a number of reasons. The environmental issues have provided tremendous impetus and the Region's experience with LIDES and with both MOSS and ARC/INFO have given us a head start in recognizing the value of utilizing the most efficient technology possible. These experiences have also emphasized the need for a well-trained and responsive staff. The field demands are often intense and require immediate attention to critical timelines. Geometronics logs approximately 100 calls per week requesting assistance with **LTPlus** and other related applications. The questions vary tremendously in complexity and in the category of responses required. Staff efforts involve telephone assistance, software

support, field visits and in-house digital data collection and processing. Many of the requests are from outside of the Region and sometimes from other agencies as well as from private contractors. Currently, three staff members spend 25-75% of their time responding to these field needs.

The Future for LTPlus

This application will not just disappear when the national GIS procurement occurs. The UNIX-based 386 machines do, in fact, match the workstation requirements detailed in the most recent GIS hardware RFI document. That was intentional. The **LTPlus** hardware and operating system specifications were based upon government-wide requirements and the 386+ platform was selected because it was already prevalent throughout the agency. A member of the CS&T staff involved with the GIS hardware procurement advised WO, Geometronics that the **LTPlus** systems were compatible with one or two of the workstation levels identified in the RFI.

With regard to the **LTPlus** software, it was developed to meet a need that could not be met by any commercially-available software at the time. **LTPlus** will not degrade the integrity of any data that it processes. If the information meets national map accuracy standards at the time of input (be that digitizing, scanning or importing), **LTPlus** will maintain that level of accuracy. **LTPlus** also outdistances all other digitizing applications in terms of the "user interface." It provides a tremendous amount of flexibility while remaining friendly to the user.

USING THE GEOGRAPHIC INFORMATION SYSTEM (GIS) AS AN AID IN THE RESOURCE MANAGEMENT DECISION MAKING PROCESS
** AN EXAMPLE **

Prepared for:

SEVENTH NATIONAL MOSS USER'S CONFERENCE
PORTLAND, OREGON
"MOSS: TRANSITION INTO THE FUTURE"

Presentation and Designs by:
Jim Dryden
Area Manager, BLM

Maps prepared by:
Neil Simmons
Geologist, BLM

Printing of Maps and COS charts by:
Jack Sheffey
Utah State Office, BLM

Slides taken by:
Gerald Sintz
Utah State Office, BLM

OBJECTIVES

[Note to reader: This report was originally presented entirely as a slide show. No pictures will be reproduced here, but all GIS maps and COS charts are present. Map 2 was deleted, also.]

OBJECTIVES *

- USE OF GIS FOR IDENTIFYING POTENTIAL CONFLICTS
- IDENTIFY SPECIFIC LOCATIONS OF CONFLICTS
- LIMITATIONS AND "OPPORTUNITIES" OF THE SYSTEM

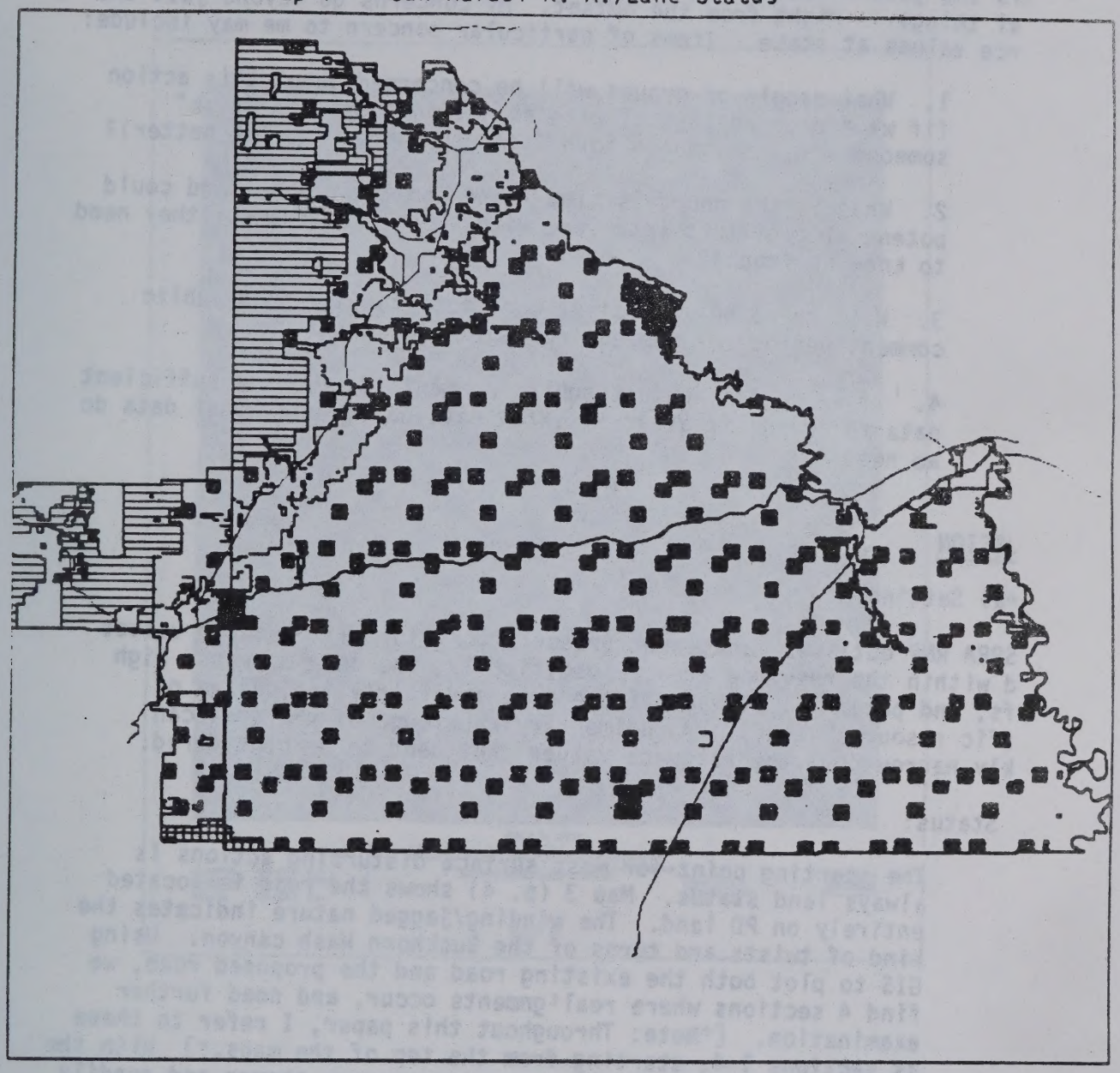
* Chart produced using the Cartographic Output System (COS)

First of all, I am not a computer specialist. I do not know all of the ins and outs of how MOSS, GIS, and other systems work, but I have come to understand what they will do for me. A manager needs to understand the implications of any action, and a visual representation usually makes things easier to understand. Specifically, I need to know what the conflicts are, how significant they are, and where they are. When using mapped information I also need to know how good (or accurate) the information is that is being displayed. BUT in addition, I am very aware of whom will be interested or concerned with various projects, locations, or resource values. This is the perpective I would like to bring to this paper.

INTRODUCTION

The BLM office in which I work is the San Rafael Resource Area (SRRA) located in SE Utah, in what is referred to as Castle Country and Canyon Country, due to the unique geologic formations found. Of particular note to this area is a large uplifted and vastly dissected area called the San Rafael Swell. It is characterized by narrow drainages bounded by steep canyons and cliffs. The area is extremely scenic and due to the terrain, has limited intrusions. Due to the inaccessibility, much of this land has remained in the public domain (PD) and is now managed by the BLM. The SRRA is 90% PD (see Map 1, p. 2). The primary road system in the

Map 1 -- San Rafael R. A./Land Status



area consists of I-70, 2 state routes, and a series of generally unpaved county roads. The main artery traversing north-south in the Swell is the road of concern here. It links the northern part of the Swell with I-70. The popularity of the area has increased dramatically in recent years and the increased use of this primary route has caused the need to upgrade the road. The county has planned the initial steps of this project through an area called Buckhorn Wash. The work planned would include upgrading of the entire portion, realigning 3 sharp curves and replacing the bridge crossing the San Rafael River.

Buckhorn Wash is a large, but intermittent drainage, with access provided by an improved gravel road skirting the eastern side of the narrows -- along the canyon wall. The road crosses the San Rafael River, near the mouth of Buckhorn Wash, where the new bridge is planned.

is the general setting. From a managers perspective, I need to know al things -- right from the outset. My concerns go beyond just the rce values at stake. Items of particular concern to me may include:

1. What people or groups will be concerned about this action (if we are going to deal with an action that will "tick" someone off, the sooner both I and they know it, the better)?

2. What is the county's time-frame for the project and could potential conflicts interfere with these time-frames (they need to know up front)?

3. Will there be sufficient conflicts to warrant a public comment period for the environmental document?

4. If we decide against public comment, do we have sufficient data to "ward off attacks" (What data do we have, what data do we need)?

JSSION

ral Setting:

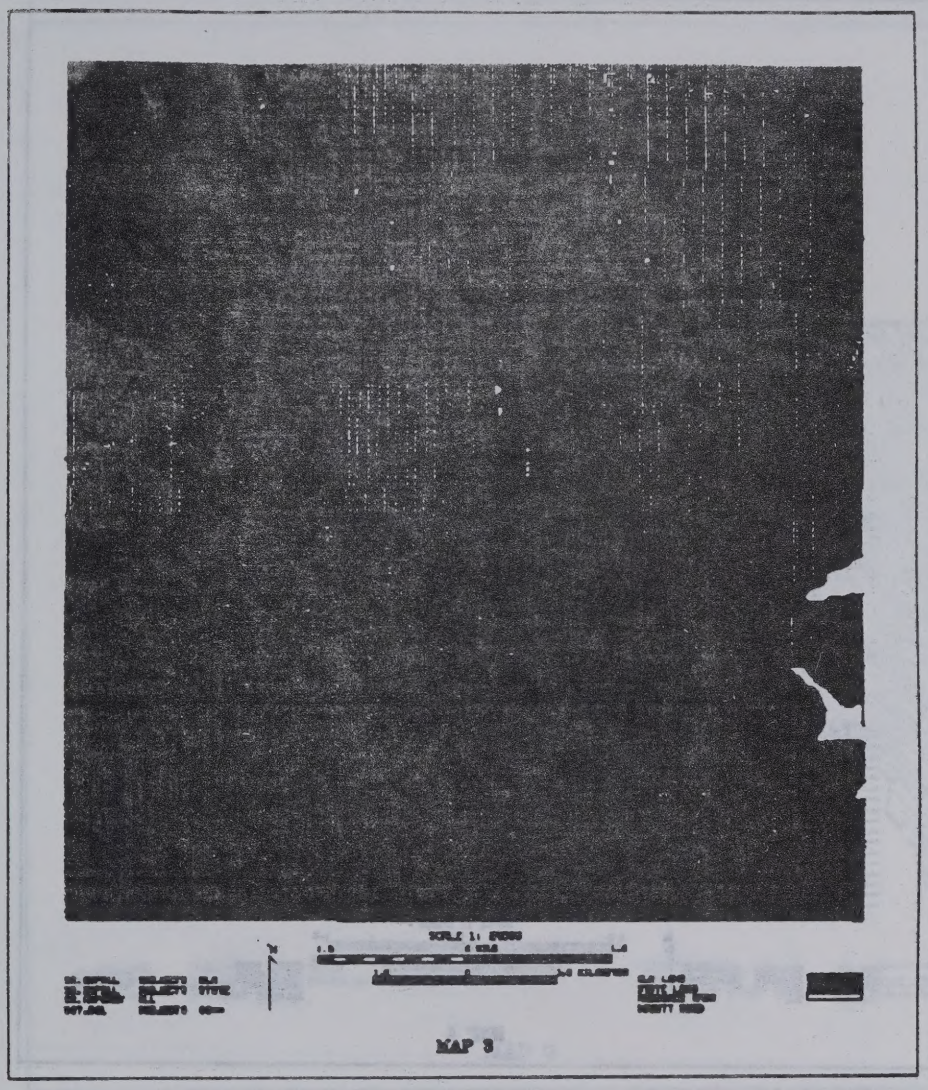
SRRA RMP outlines management prescriptions for all resource values d within the resource area. Specifically, the deep canyons, high fs, and perennial streams of the area are fairly indicative of ific resource values. A rudimentary knowledge of the area can kly narrow down the resource values that need to be considered.

Status:

The starting point for most surface disturbing actions is always land status. Map 3 (p. 4) shows the road is located entirely on PD land. The winding/jagged nature indicates the kind of twists and turns of the Buckhorn Wash canyon. Using GIS to plot both the existing road and the proposed road, we find 4 sections where realignments occur, and need further examination. [*Note: Throughout this paper, I refer to these as sections 1-4, starting from the top of the maps.*] With the road plotted we overlayed numerous resource themes and readily identified the potential conflicts of greatest concern. The resource themes we examined were as follows:

Wilderness Study Areas
Cultural Resources
ACECs and Visual Resources
Wildlife Habitat: Raptors and Desert Bighorn Sheep
Riparian Habitat
Antelope Habitat
Grazing Allotments
Mineral Resources

Map 3 -- Buckhorn Road with Land Status (zoom)

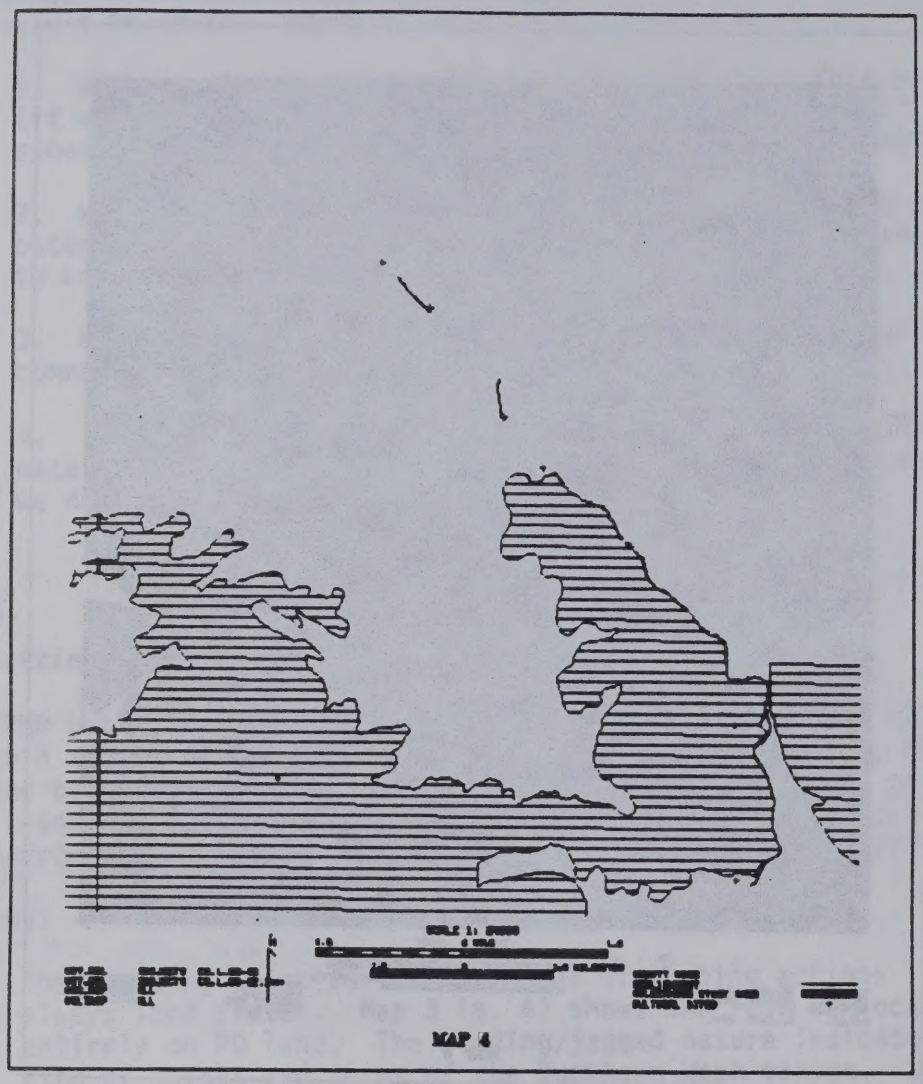


Resource Values (from GIS Themes):

Wilderness Study Areas (WSA's):

We were well aware of the proximity of WSAs in the area, but were not certain of exact boundaries. Buckhorn Wash is bordered on both sides by WSAs (Mexican Mountain - east, and Sids Mountain - west). The boundaries often appear peculiar -- the cliffline in some places, the road in others (See Map 4 p. 5). Using GIS to zoom into specific road sections, we obtained a better view of where the boundaries were situated,

Map 4 -- Buckhorn Road/WSAs



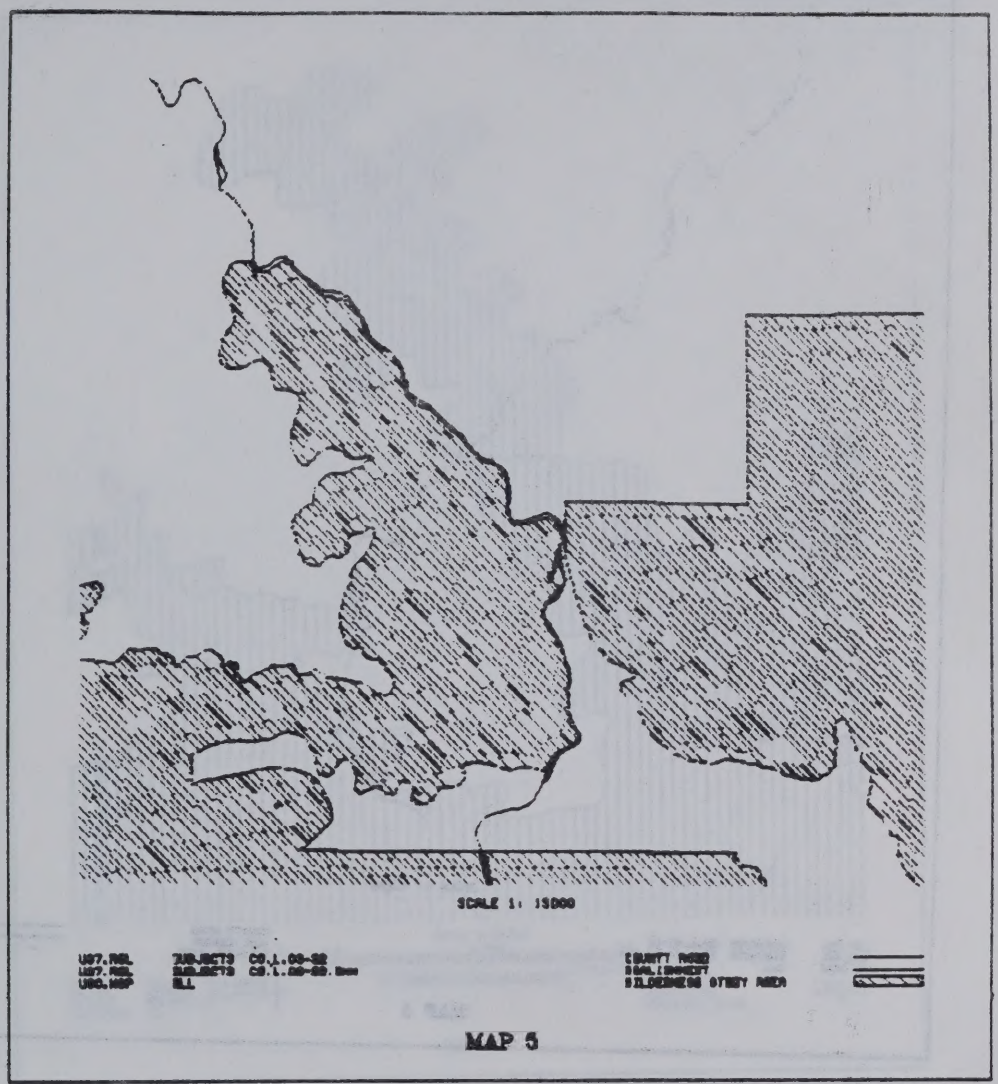
relative to the new alignments (See Map 5 p. 6). The WSA theme overlay indentified 2 sections of the realignment which will need to be examined and watched closely, due to close proximity to the boundary line.

Cultural Resources:

Of extreme importance throughout the SRRA is cultural resources, as is evident by numerous rock art sites of the Fremont Indians. This rock art is the principal artifact that remains of this ancient culture. It is, therefore, not only interesting, but very significant.

Four known sites are presently recorded along or near the proposed road, and it can easily be concluded that additional undiscovered sites are likely. It should be noted that 2 sites

- Map 5 -- Buckhorn Road/WSAs (zoom)



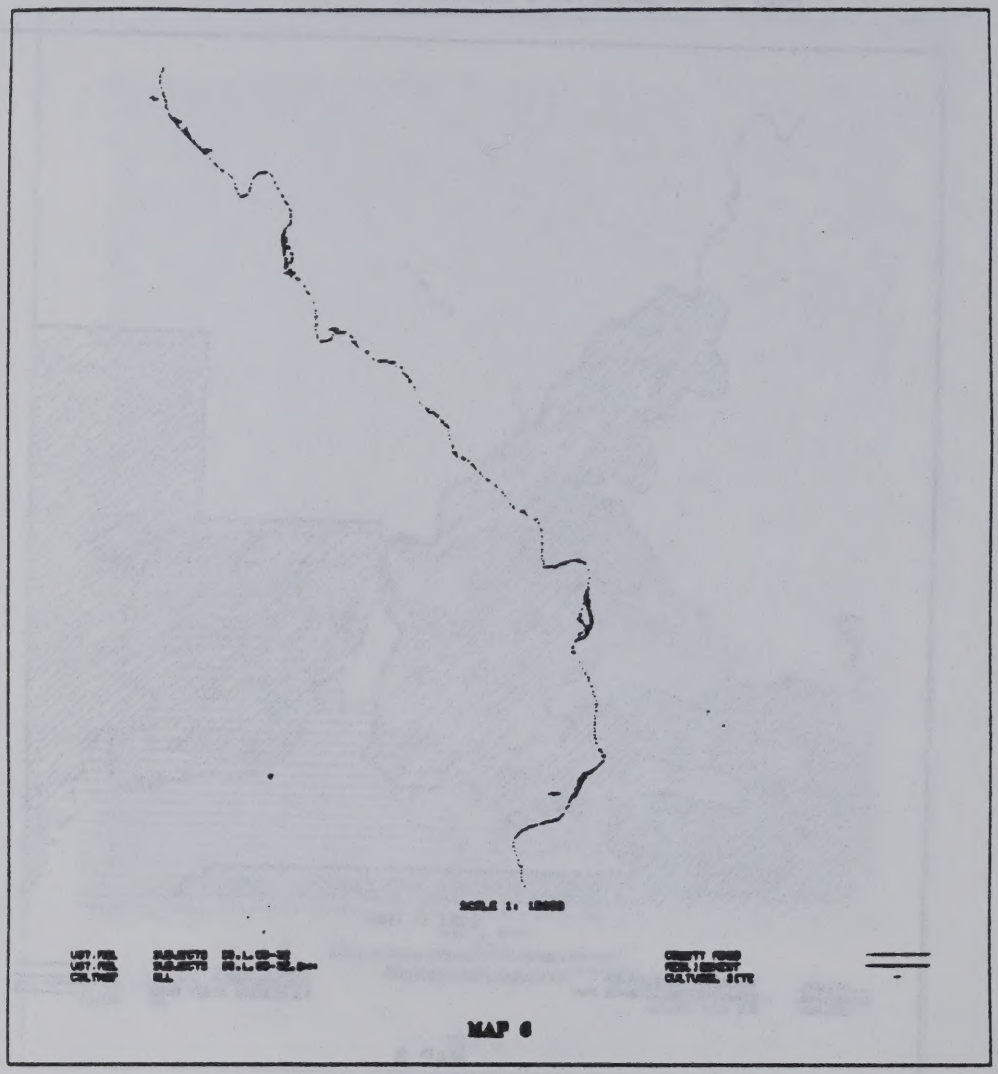
are located immediately adjacent to the road. Road construction near rock art panels can present a problem, due to the obvious impact of earth moving equipment. (See Map 6 p. 7)

ACEC/RNA:

Given the existence of 2 WSA's, as well as the scenic values of this area, the next logical theme to look into was the visual class ranking. Map 7 (p. 8) shows that this area is within a VRM Class II area -- fairly restrictive. In addition, our RMP outlines this VRM Class II area as the Middle San Rafael Canyon ACEC.

Also shown on Map 7 are raptor nest sites, with a large number located with in the canyon. This leads us into the next subject -- wildlife.

Map 6 -- Buckhorn/Cultural Sites

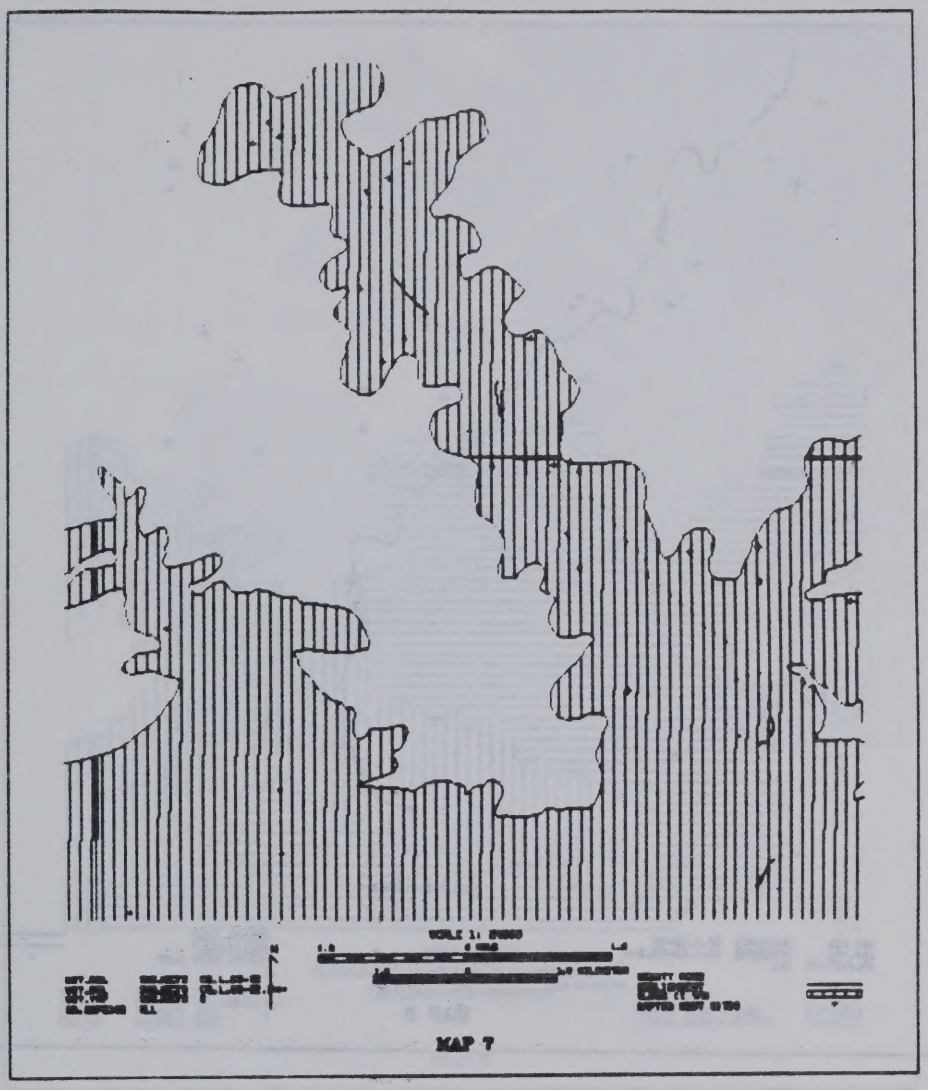


Wildlife:

Raptors:

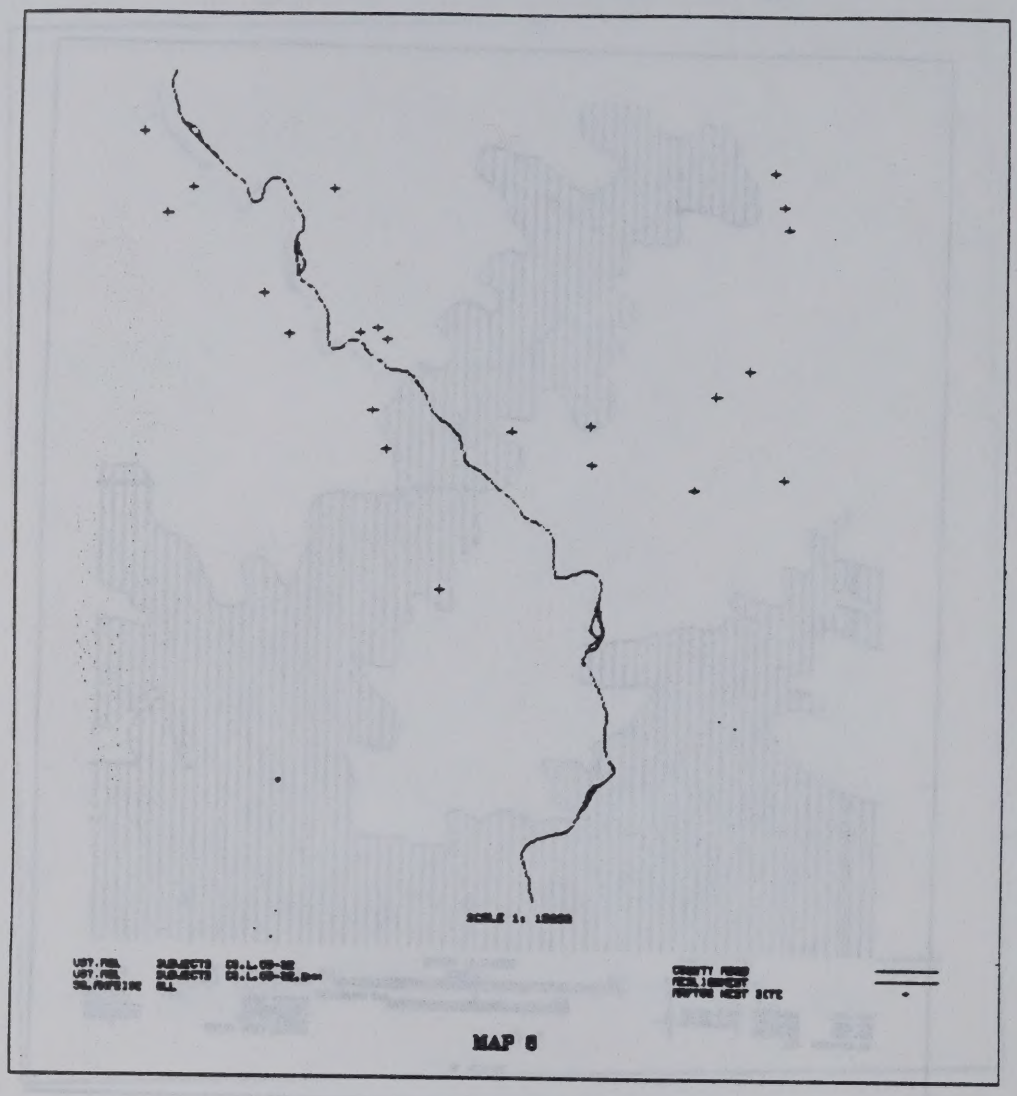
The broad canyons; steep, stream-cut drainages; and high mesas are indicative of a wide variety of wildlife habitats. The canyon walls are ideal for raptors, and our data shows that. Examples of raptors, such as the red-tail hawks are readily found. Of special concern to this area is a pair of peregrine falcons, which have nested here for the past 4 years.

Map 7 -- Buckhorn Road/VRM Class II



A closer look at Map 8 (p. 9) shows at least 12 nest sites adjacent to the road, with 5 very near the proposed realignments, where significant construction will occur. Should any of the nests become active, we have a conflict requiring mitigation.

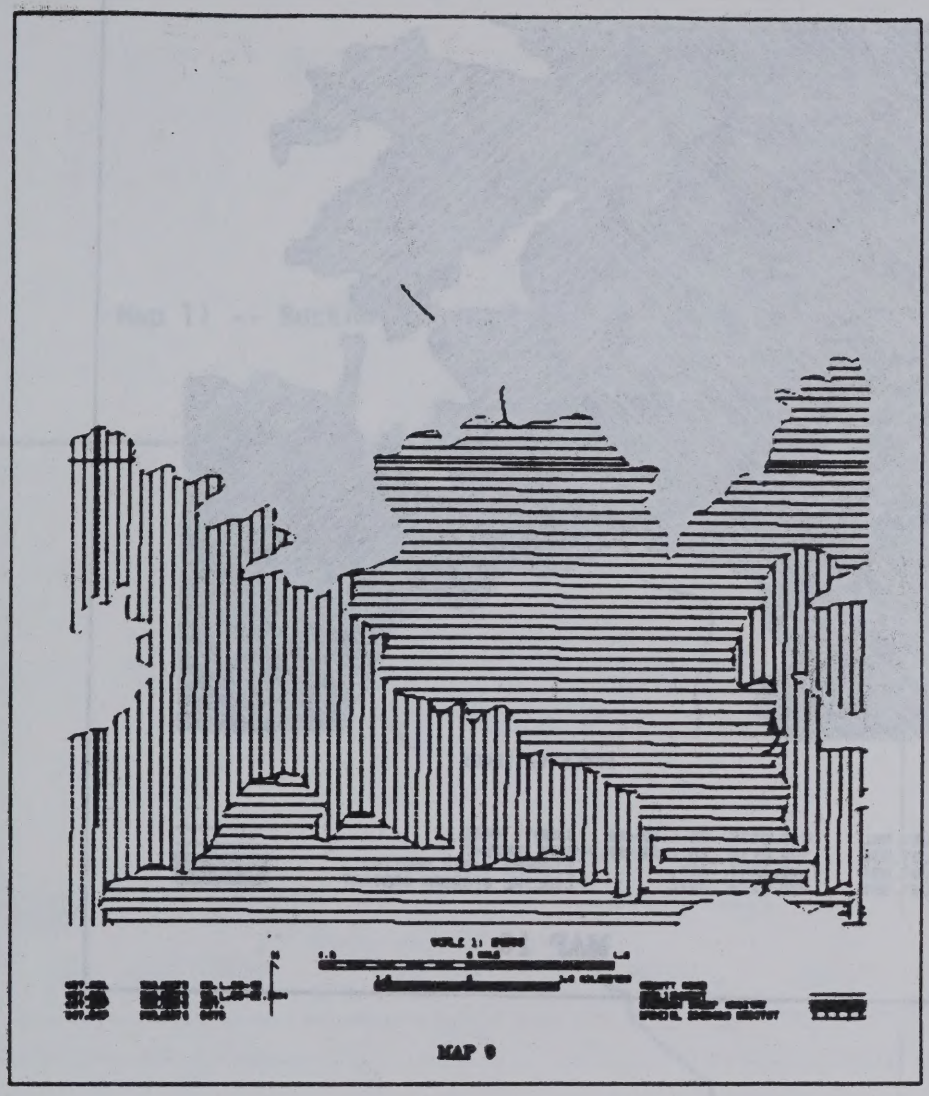
Map 8 -- Buckhorn Road/Raptor Nests



Desert Bighorn Sheep:

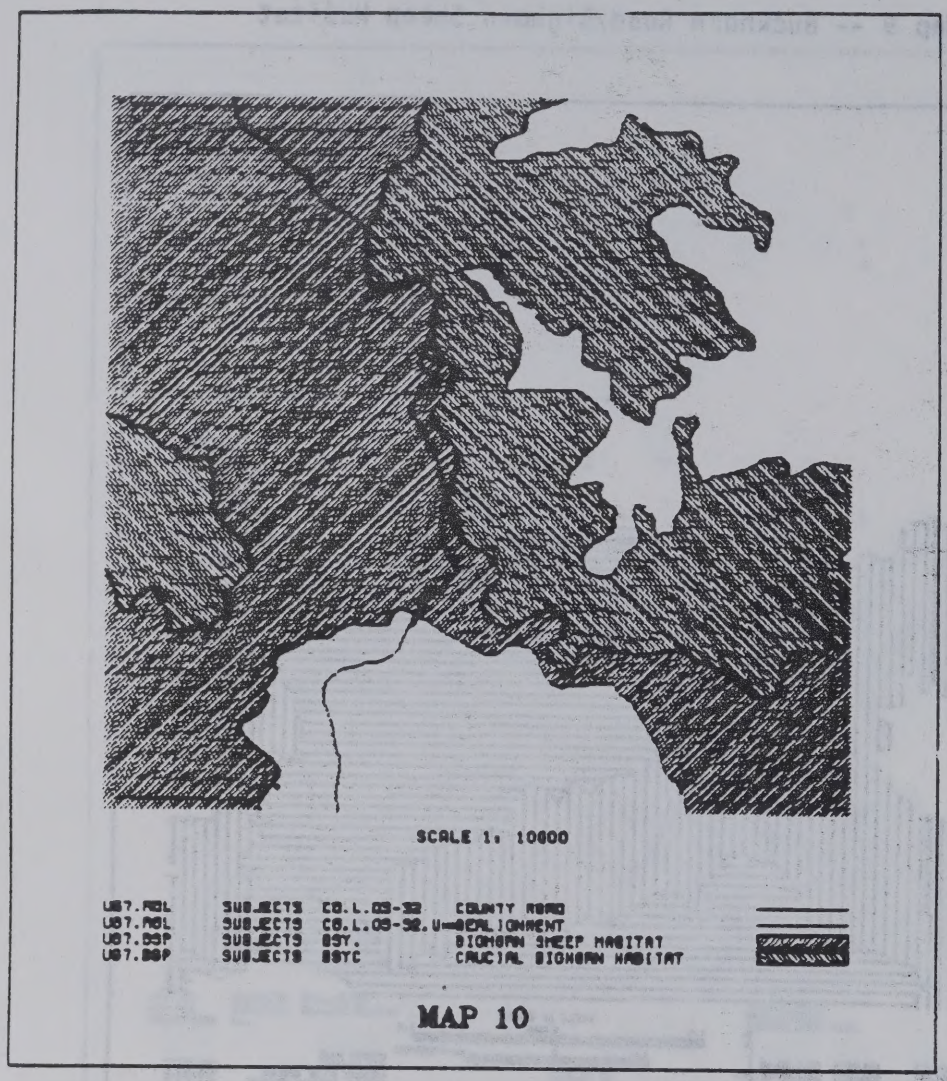
One of the more significant species found in the Swell is the desert bighorn sheep. The rocky canyon country is ideal habitat for this species of national interest. Map 9 (p. 10) illustrates both yearlong and crucial habitat. These 2 themes show immediately the potential conflict with alignment sections 3, 4 and possibly 2.

Map 9 -- Buckhorn Road/Bighorn Sheep Habitat



Map 10 (p. 11) presents a zoom of areas 3 and 4 showing an even greater potential for conflicts at realignment sections 3 than may have been thought. The existing road is in yearlong habitat, whereas the new alignment will enter crucial habitat.

Map 10 -- Buckhorn Road/Bighorn Habitat (zoom)

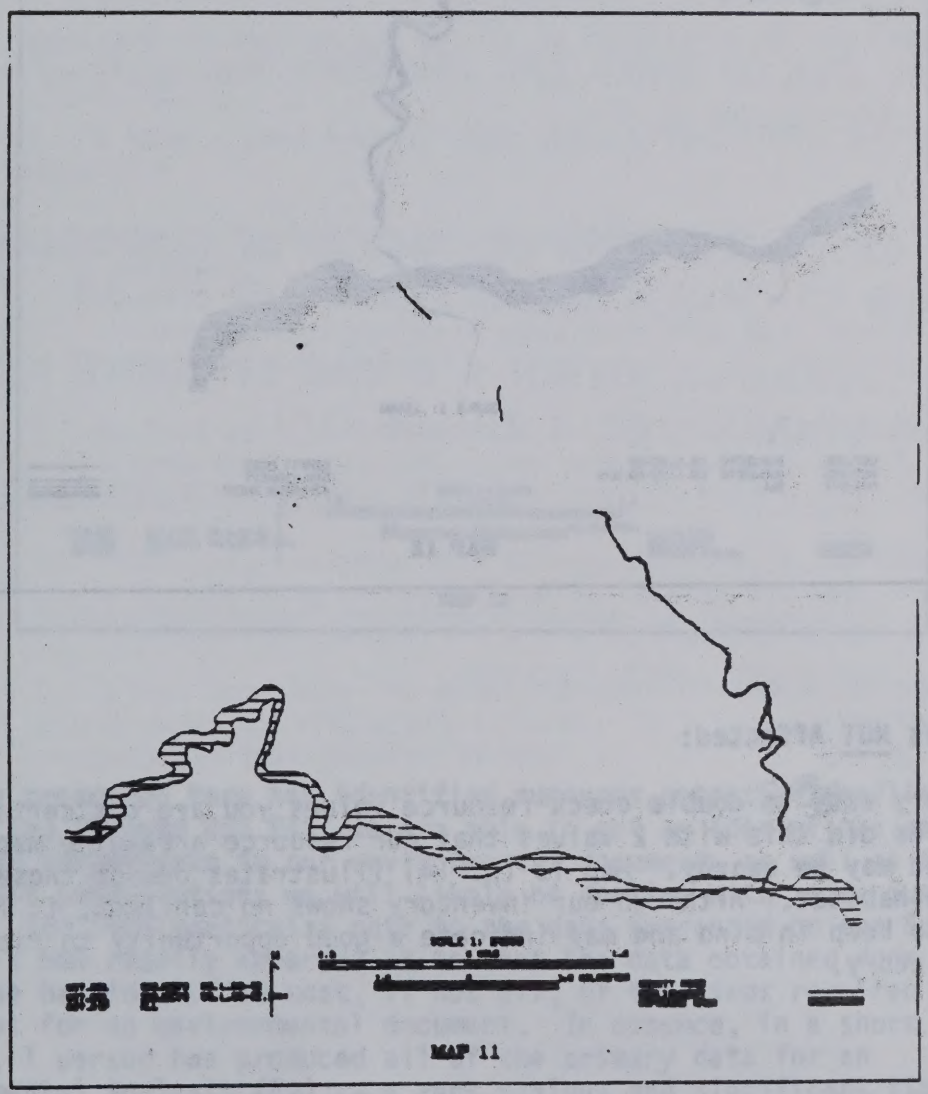

SCALE 1: 10000
USFS.RDL SUBJECTS CO.L.03-32 COUNTY ROAD
USFS.RDL SUBJECTS CO.L.03-32.U=REALIGNMENT
USFS.BSP SUBJECTS BSY. BIGHORN SHEEP HABITAT
USFS.BSP SUBJECTS BSYC CRUCIAL BIGHORN HABITAT

MAP 10

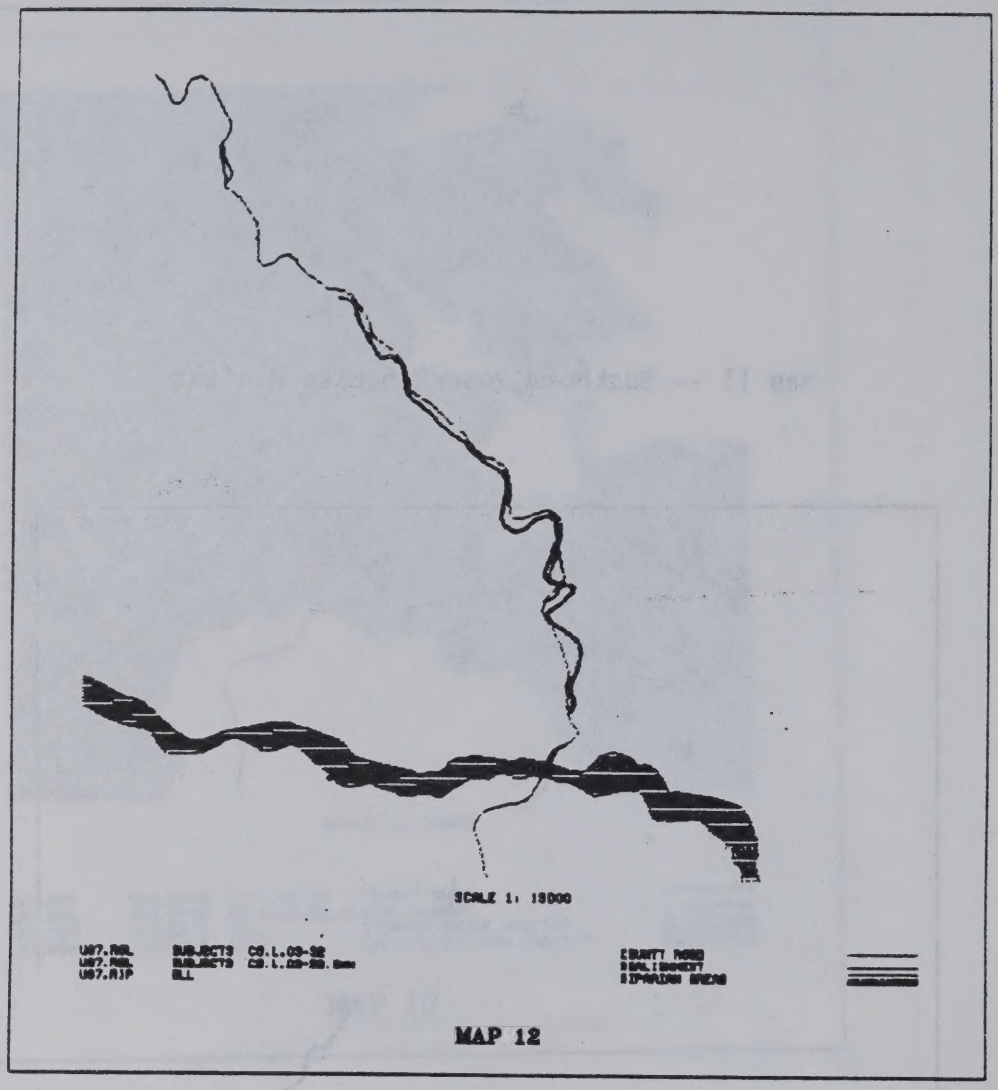
Riparian Habitat:

Of more recent importance to public land management agencies is riparian habitat. Any road realignment within a narrow canyon bottom can be tricky. Very limited space is generally available for changes, and those changes often impact either the stream channel or adjacent riparian vegetation, or both. The interaction between the road and the wash bottom/riparian are is evident in Map 11 (p. 12). On closer inspection it is apparent that significant effort will be required to mitigate work around realignment section 3 (See Map 12 p. 13).

Map 11 -- Buckhorn Road/Riparian Habitat



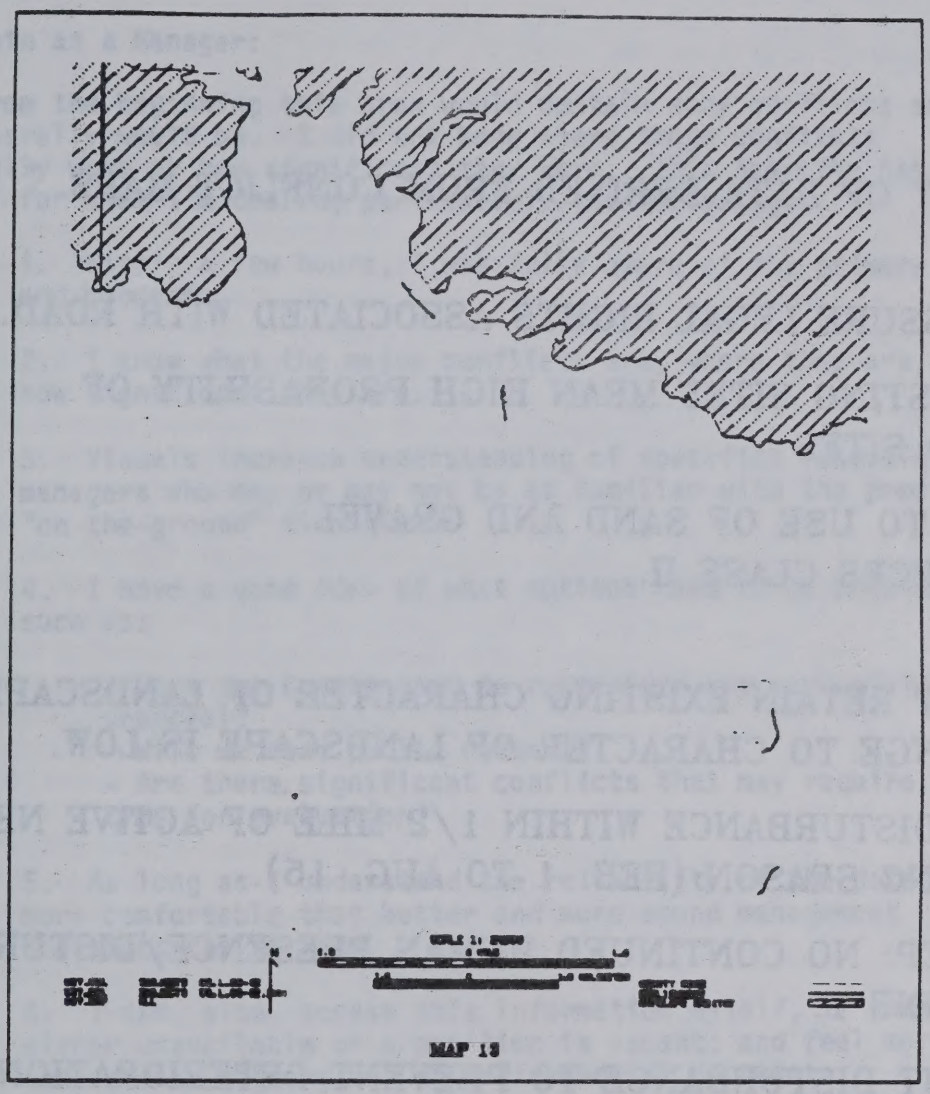
Map 12 -- Buckhorn Road/Riparian Habitat (zoom)



Resources **NOT** Affected:

It is very easy to double check resource values you are not certain about. We did this with 2 values that our resource area-wide maps indicated may be nearby. Map 13 (p. 14) illustrates one of those -- antelope habitat. Although our inventory shows no conflict, it is close enough to keep in mind and may indicate a good opportunity to field check our inventory.

- Map 13 -- Buckhorn Road/Antelope Habitat



SUMMARY

The data presented here has identified numerous potential conflicts. Through the [redacted] WSA EIS, we are able to get an idea of the values we will need to [redacted]ate in our environmental document, as well as the management p[redacted]iptions we will likely be dealing with (See Summary Sheet p. 15). [redacted] particular note to the data presented on the Summary Sheet, is how readily apparent it is that the data obtained from the GIS data base has identified most, if not all, of the items required on the checklist for an environmental document. In essence, in a short period of time, 1 person has produced all of the primary data for an Environmental Analysis (EA) -- a very obvious and significant time saving method for EA reports.

SUMMARY OF DATA DERIVED FROM CONFLICT MAPS *

WSAs: MUST ASSURE LEGAL RIGHTS ASSOCIATED WITH ROAD.

CULTURAL: EXISTING SITES MEAN HIGH PROBABILITY OF UNDISCOVERED SITES

ACEC: CLOSED TO USE OF SAND AND GRAVEL.
VISUAL RESOURCES CLASS II.

VRM CLASS II:
CHANGES MUST RETAIN EXISTING CHARACTER OF LANDSCAPE.
LEVEL OF CHANGE TO CHARACTER OF LANDSCAPE IS LOW.

RAPTORS: NO DISTURBANCE WITHIN 1/2 MILE OF ACTIVE NESTS DURING NESTING SEASON (FEB. 1 TO AUG. 15).

BIGHORN SHEEP: NO CONTINUED HUMAN PRESENCE/DISTURBANCE FROM AUG. 15 TO JUNE 1.

RIPARIAN: LIMIT DISTURBANCE TO PREVENT DETERIORATION.
CLOSED TO USE OF SAND AND GRAVEL.

NO CONFLICTS WITH:

- MINERAL POTENTIAL
- GRAZING
- ANTELOPE HABITAT

* Chart produced using the Cartographic Output System (COS)

CONCLUSIONS -

What I gain as a Manager:

I knew from the beginning this area would contain many conflicts and what those generally would be. I did not know where those conflicts specifically were or how significant they were. This exercise has given me a feel for what I'm dealing particularly the following:

1. Within a few hours, I was fully aware of the primary issues and concerns.

2. I know what the major conflicts are, where they are, and how significant they are.

3. Visuals increase understanding of specifics (especially for managers who may or may not be as familiar with the precise "on-the-ground" situation).

4. I have a good idea of what options need to be considered, such as:

   - Does the County need to reconsider any part of their proposal?
   - Will we need public comment?
   - Are there significant conflicts that may require more time for evaluation?

5. As long as I understand the reliability of the data, I feel more comfortable that better and more sound management decisions can be made.

6. I can, also, access this information myself, if someone is either unavailable or a position is vacant; and feel more comfortable signing off on environmental documents.

7. I have used many GIS maps and COS flipcharts in local public meetings with great success. It gives a much more professional presentation of data.

PROBLEMS/OPP[redacted]TIES

-- Our office [redacted] yet to develop what I consider to be an easy system for updating data. An ever increasing use of the system has increased the demand on digitizing, etc. Even so, this project introduced us to one new option when dealing with the County. Normal procedures have been for the County engineers to survey all roads using points relative to the road itself. They have now agreed to tie all future surveys into known survey points -- thus, making our digitizing both easier and more accurate.

-- Our present system has no information regarding who gathered the data, when the data was collected, or how reliable the data is. (This information is available, but not within the system itself.) There is not always a need to have 100% accurate data: but those using the data (including managers) must know how good or reliable it is.

So what began as a typical road realignment, using the data located in GIS, we have identified significant resource conflicts. In addition to identifying what we know, the GIS has also shown us what we need to find out.

EPILOGUE/"EDITORIAL"

As a manager having gone through the entire RMP process using the GIS, I have come to realize several things about both the system and people that I would like to emphasize in this closing. First of all automation of resource data is an expensive enterprise, and the BLM (and other agencies) have only begun the process. It has been firmly stated at the highest level that automation is here to stay, but the utility of our present system has yet to be convincingly demonstrated to everyone. It is quite apparent to many that the GIS is extremely useful in the preparation of large documents (RMPs, EISs, etc.), but the utility for day-to-day work has not been adequately illustrated to may field managers and staff. It has been pointed out to me on numerous occasions by GIS Coordinators, Data Administrators, and others, the frustration felt because of this situation. So as a field manager that is convinced, I would like to issue this challenge to those feeling this frustration. Keep your eyes and ears open. When you hear a manager or staff member discussing an action or resource problem/conflict, think of how you can provide GIS assistance -- maps, data, COS charts -- whatever. If some people still need convincing -- LET'S CONVINCE THEM! Please don't fall back into the "I have too much to do" syndrome, because we all have too much work -- but some things are too important to leave to "someone else". Invest the time and energy in promoting your program and your work, and everyone will benefit -- the agency, the program, and you.

ENJOY!

November 6, 1990

"MOSS: Transition into the Future"

ABSTRACT- Using MOSS in an operational environment requires a drastic change in thinking from the static view of a Resource Management Plan (RMP). This change is very well illustrated by the Forest Inventory theme. Updating and maintaining forest operational inventory (FOI) data require a structural view of the total environment from creating inventory data to producing output products. As this data interfaces with other data fields and other activities, the user begins to see the total integration of forest activities and how MOSS can enhance these activities while keeping FOI current.

BACKGROUND- For The Bureau of Land Management in western Oregon,"transition into the future" is paramount to moving from a static database of GIS information frozen in place as of October 1, 1988 to a moving, dynamic, ever changing set of GIS data needing continual update. This is exceptionally illustrated by the Forest Operational Inventory (FOI). The FOI is an inventory of forest types and stand conditions depicting the current status of the timber resources in the forest at any given point in time. Because activities continually change the composition and structure of the forest, a continual monitoring process is necessary to record those changes and to inform the forest managers of the current status. The more obsolete the information, the less reliable the data, the more likely that the forest manager will make poor and improper decisions. The data must be kept current.

The Bureau of Land Management in Western Oregon began about five years ago to build a Geographic Information System (GIS) to analyze and build a total land management program for the six western Oregon O&C districts for a ten year period. This Ten Year Plan or Resource Management Plan (RMP) includes, among other things, what and how the timber resources will be managed for that period. As envisioned, this GIS is also designed as an operational system to monitor and record on going activities and provide necessary information to the forest manager so he can evaluate potential conflicts, recommend mitigating measures and prepare long range plans.

In order to evaluate the current situation for the RMP without having to shoot, as it were, at a moving target, a decision was made to freeze the data on the first of October, 1988 for the RMP. With the addition of transitional information to account for changes to the timber resources during the time of building and evaluating the GIS database, the Bureau has the necessary components to complete the Resource Management Plan.

For operational purposes, however, a frozen database does not provide the necessary information to make land management decisions. To make good land management decisions, it is important to have all the necessary information available to determine potential conflicts, evaluate reasonable alternatives and draw viable solutions from those alternatives. To have poor or obsolete data is sometimes worse than having no data at all because it can misinform the user and lead him in the wrong direction.

The question then becomes how does the manager keep his database updated so he can be sure the data is current?

Before this question is answered, an understanding of what happens in the field helps formulate the process in ones mind, and explains the interrelationships between various activities that occur spatially in time and place.

From the Resource Management Plan, the districts are allocated an allowable cut. The cut is then divided by fiscal Year commitments and an annual harvest plan is developed. The individual timber sale units make up the majority of the annual commitment with small sales and other miscellaneous inputs rounding off the requirements. Unless fire or some other disaster occurs, the major modifications to the timber resources change in this way. Once sales are sold and logged they are site prepped, planted, thinned, fertilized, commercially thinned and so forth through to the next rotation. To keep track of all the changes taking place throughout this complex process, an inventory system is in place documenting those changes, and recording the results of those changes. Prior to GIS, the inventory was kept in one place while the graphics data was kept manually on maps and overlays. GIS changed this. Now, the inventory information is in a database linked to township sized maps of polygon data. This is what currently exists in MOSS in a frozen structure for the RMP.

PROCEDURE- A number of things come into play in actually updating and maintaining FOI in the GIS environment.

1. Part of the routine of preparing timber sales, once the units are laid out, is to traverse the units to determine acreage, and prepare exhibits for the timber sale contract. If units are not traversed, then other means are used to capture the changes to the timber resources and acres determined. In keeping with this, GIS takes the data derived by the timber sale activities and captures them in ADS and eventually in MOSS.
The process of doing this takes one of several avenues.

a.If the timber sale unit is traversed, the traverse data is worked up using Traverse PC. The ascii file is cleaned up and transferred to ADS using Primelink. The critical requirement here is that the sale layout people traversing the unit must know the coordinate pair for the beginning point. This information can be obtained from

MOSS using the "where" command. It must be remembered that MOSS units in Western Oregon are in state plane meters and must be converted to state plane feet prior to using them since the field people work in feet. Other accurate means are available for obtaining the needed information.

b. If the unit is not in traverse format, the information can be entered directly into ADS either by digitizing data from a scaled map or by free hand digitizing. These two options are less accurate than using actual traverse data.

2. Once the timber sale traverse data is captured, it is primelinked into a work area in ADS, converted from units in feet to units in meters and put onto a theme called "presale." Other themes are also plotted to reference the accuracy of the traverse placement. Does the unit follow the road? Does it intersect the stream where it is supposed to? If minor adjustments need to be made to the data, they can be done in ADS; otherwise the user will have to go back to the Traverse PC program or field notes to correct the problem.
After the data is verified as correct, the units are duplicated onto a theme called "exhibit." Here, along with the units, other information is added to provide the necessary information to prepare exhibits for the timber sale. The "exhibit" theme is then taken into MOSS and the data is further massaged. An export "DXF" file is then created separating the various subjects into layers for later use in AutoCAD. This program also converts the units from meters to feet.

3. An AutoCAD drawing is created using the DXF file data and the final exhibits are prepared. A number of macros are written to facilitate processing. Standard templates are written, standard symbols are used, and standardized conventions are established. The flexibility to edit and manipulate data makes AutoCAD the software of choice to complete the final exhibits. The DXF file data is in polyline format so the user can shade and perform functional procedures.

4. After the timber sale is sold, the inventory specialist creates a field in Micro*Storms, an inventory program, for each new unit and assigns the field a six digit subject name. The specialist then goes into ADS, duplicates the new units onto the FOI theme, and edits the FOI to clean up the loose ends created by the addition of new data. Once the changes are made and checked for accuracy, the updated map file and Micro*Storms file are linked and transferred to MOSS.

That, succinctly is the procedure for getting changes into GIS. As one can see, the work of FOI is interrelated to timber sales, and the spin off is an integrated system of activities. It is

anticipated that some time in the not too distant future, the Timber Sale Information System can also be integrated into this as well.

SECURITY- With data constantly changing, the question of master data, security, and integrity become very important. File management plays a large part in the process of operational GIS. For the Bureau in Oregon, we have decided that our master data will be in ADS and kept on tape in the State Office. When someone wants to update an FOI theme map the user must comply with the following procedure:

1. Only individuals involved as a part of a work group will be able to request and receive master data for update. The members of the work group are decided by the Resource Area Manager. For the FOI update procedure just described, members from the timber sale layout team, the timber manager, the inventory specialist, and area silviculturist will probably constitute the work group.
2. Those individuals access a menu on the Prime in Portland, identify themselves and select which maps they want to work with.
3. The data manager in Portland validates the user and load the requested materials. Currently portions of the process are manual, but soon will be automated. The needed files are loaded in designated work areas to which only the work group has access.
4. Only the theme lead has access to identify and return the data as updated. This is done only after the data is reviewed by the theme lead and is verified as quality checked. Only the theme that was updated is checked back in. The other maps used for reference are discarded. In the case of the "presale" theme, the timber manager is the theme lead. The theme lead for FOI is the resource area silviculturist.
5. Only after the timber manager or area silviculturist have reviewed the theme being updated and verify the data is correct does the State Office data manager update the master tape.

FUTURE DEVELOPMENTS- A number of future developments are on the horizon that look promising to help stream line the activities described above:

1. The Global Positioning System (GPS), often called the satellite positioning system, along with the Path Finder or other similar equipment enable the field personnel to gather field data in an accurate and fast manner directly into an electronic database format rather than having to write down the information and then transferring to an electronic environment by retyping the information. This should avoid many errors of the past. The number of satellites available right now limit the number of hours the timber sale units can be traversed using GPS, and in dense timber, the signal is difficult or impossible to read. These problems are being

worked on, so the Global Positioning System appears to be very promising.

2. The current use of Micro*Storms as a database manager will be reevaluated once the MOSS-Oracle bridge is functioning. It may be that we will still use M*S in the PC environment or we may consider changing completely to Oracle.

3. The current manual processes of data security, retrieval, update, and return is currently being evaluated and automated. Soon the computer will do all the manual steps except retrieve and mount the stored data tapes. After a trial period management will reevaluate the decision of maintaining the master data at the state office rather than at the district.

IN SUMMARY - Managing timber resources in the future will require the forest manager to have a good grasp of the current status of the forest resources and to be able to evaluate alternative solutions to pending problems. In order to do this the manager must have current and accurate data at his finger tips. Updating and maintaining the current inventories in a computer environment require input from many disciplines on a timely basis. To update the forest inventories, input will come from the timber staff by way of timber unit traverses. The timber staff in turn will benefit by getting DXF files from which exhibits can be prepared in AutoCAD. FOI benefits by receiving updated information of changes occurring in the forest.

USERS GUIDE - The BLM in Western Oregon has a users guide for the technical aspects just described. The guide takes the user step by step through the entire process beginning with the traverse notes and ending with an updated FOI. Copies of the USERS GUIDE EXHIBIT A PRODUCTION AND FOI THEME UPDATE are on the table with a poster illustrating the flow of the process. Thank You.

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GIS IMPLEMENTATION AT THE DETROIT RANGER DISTRICT OF THE WILLAMETTE NATIONAL FOREST

by Raoul W. Gagne
Integrated Resource Analyst

Paper Presented at:
SEVENTH NATIONAL MOSS USER'S CONFERENCE
Portland, Oregon
November 26-30, 1990

There were these two hunters that had struck off into the woods. By the time they had bagged their limit of rabbits, they knew they were lost.
"Now what do we do?" asked one of them worriedly. "We'll never find our way out of here by dark."
"No problem," said the other. "We'll just shoot one more rabbit, and the game warden'll find us within five minutes."

There are times when resourcefulness is required to get you out of some difficult spots. The Detroit Ranger District was in a difficult spot a year ago and we decided to speed up the implementation of the District's geographic information system, MOSS, to get us out of the dark.

Our success in MOSS implementation was achieved because of strong support from the managers on the District and an organization willing and able to do the work. Today, I will focus on why we had that strong management support and how we were able to create an organization capable of accomplishing such a large project.

Background

The Detroit Ranger District is the northernmost District on the Willamette National Forest in Region Six. (Figure 1) The 300,000 acre District is within the North Santiam River Drainage along the western edge of the Oregon Cascades. The Ranger Station is about 50 miles east of Salem, the State capitol of Oregon. The District encompasses 78 percent of Salem's watershed, has one of the states largest reservoirs with an extremely high recreation use, is heavily embroiled in the many old growth and wildlife issues, and is the home of Opal Creek. For those who may be new to the region, Opal Creek was the centerpiece of the National Audubon special, Rage Over Trees.

Litigation over Northern Spotted Owl habitat resulted in Congressional action that mandated a timber sell level for fiscal years 1989 and 1990, while minimizing the fragmentation of old growth. This amendment to an Interior Department appropriations bill, passed in October 1989, resulted in a two year harvest level of 144 million board feet for the Detroit District. Due to administrative and judicial challenges, only 30 million board feet had been sold in 1989, so an additional 114 million needed to be auctioned by September 30, 1990. About 54 million of our 1990 target was in various stages of completion, but still required significant time to accomplish. An additional 60 million board feet had not even been started in the timber planning process, a process which usually takes 2 to 3 years to accomplish the environmental assessment, layout and cruise, contract preparation and auction.

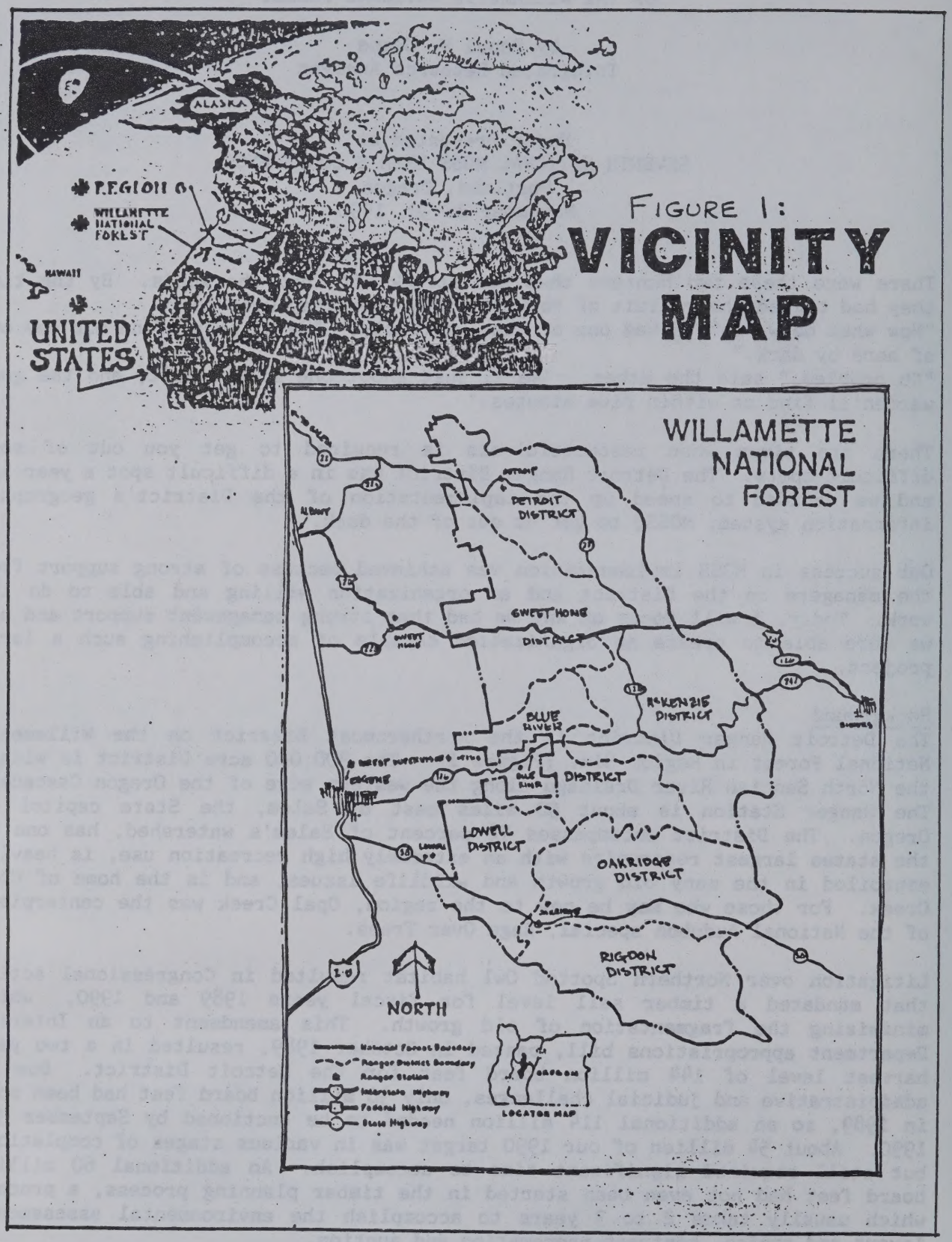

FIGURE 1:

VICINITY MAP

The District was at a crossroads, how to accomplish a difficult workload in the best of circumstances, but now had the additional pressure of a Congressionally mandated timber sell target, consultations with a public advisory board and the U.S. Fish and Wildlife Service, and ever increasing public interest.

The District management team decided to utilize a new tool we had been using in our mediated negotiations with environmental, industry and other agency interests for the Opal Creek area. We decided to approach the crisis from the opportunity perspective and implement MOSS.

In the span of eight months, for 125,000 acres of the Detroit District, we were able to draft and install 36 original resource layers at 4 inches to the mile (1:15840), over 400 maps in all. Additional resource layers were derived from this set of originals as needed to resolve management issues and conduct various cumulative effects analyses. Several of the most frequently used derived layers are noted on Figure 2.

Figure 2:
Basic Layers currently within the Detroit Ranger District GIS database.

	LAYER	LAYER THEME
#	AA	AVOIDANCE AREAS
	AW	ALTERNATIVE W
	AO	AUDUBON, ONRC, SIGNIFICANT OLD GROWTH
	CA	CULTURAL AVOIDANCE-SENSITIVE
	DS	SOILS (FIELD VERIFIED)
	E4	ELEVATION 4000 FT.
	EV	EXISTING VEG. (MOM)
	HCA	HABITAT CONSERVATION AREA
	HL	HELICOPTER LANDINGS
	HU	HARVEST UNITS FY-90
	LA	LAKES
	LE	LAND EXCHANGE
	LL	LANDLINE
	LM	LAKES, PONDS, MARSHES
	L1	US FISH & WILDLIFE LEVEL 1
	MS	MANAGED STANDS
#	NH	NO HARVEST
#	NM	UNMANAGEABLE/SILVICULTURE
#	OW	OWNERSHIP
	PB	PROJECT BOUNDARY
#	PL	PLANTATIONS
	PU	PLANNED NOT SOLD UNITS
	QTS	QUARTER TOWNSHIPS
#	RA	RIPARIAN AREAS
	RC	CAMPGROUNDS
	RD	ROAD SYSTEMS
	RS	DISPERSED SITES
	SB	SUBBASINS
#	SM	UNSUITABLE/UNMANAGEABLE
	SR	SILVICULTURE RX (FIELD)
	ST	STREAMS
	S1	SPECIAL USES (LINE)
	S2	SPECIAL USES (POLY)
	TA	T&E PLANTS AVOIDANCE
	TR	TRAILS
	TS	TOWNSHIP, RANGE, SECTIONS
#	UN	UNSUITED SOILS
	UR	UNROADED
	WC	WILDLIFE CORRIDORS
	WN	RAPTOR NESTS/SITINGS-SENSITI
	WR	WILDLIFE RAPTOR RESPONSES
	W2	WILDLIFE RESERVED AREA
	W3	WINTER RANGE
	W8	SUITABLE OWL HABITAT
	W9	NON-NETWORK PAIRS
#	47	447 OLD GROWTH

Management Support

A little over three years ago, the District was asked by the Forest to look at the expected outputs generated by the preferred alternative of the Draft Forest Plan. It became quite apparent that our old tools, such as the Total Resource Information system (TRI), would not allow us to perform the spatial analyses that would be required to implement our new Forest Plan. Another revelation during this exercise in disaggregating the Forest level outputs, was the discrepancy between the Forest database and our field knowledge of the District. Although the Forest data was reasonable accurate at a gross scale, it would not be to the level of detail that would be necessary for site specific resource planning. We began to see the need for new tools.

The District's maintenance of our existing resource database, TRI, was minimal at best. Resource inventories began to accumulate in individual file cabinets, further complicating resource planning. The integration of resource information occured during discussions at interdisciplinary team meetings to decide timber planning alternatives, but that was more coincidental than planned. We began to see the need for new tools and planning processes.

A District task force was established to evaluate our resource planning efforts and recommend any changes to the District management team that would improve the planning process and land stewardship. One of the major changes recommended by that group and adopted by the District management team was the concept of a long range planning staff group. It was felt that with major workloads anticipated in Forest Plan implementation and data base acquisitions that a separate staff group for 3 to 5 years would facilitate the transition from the OLD Plan to the NEW Plan. That group is now titled, RESOURCE INFORMATION SYSTEMS.

The mission of the Resource Information Systems group is in four areas. (Figure 3)

Data Base Development and Managment- Implement a resource data base capable of spatial analyses that all resource areas will utilize and maintain current field information.

Forest Plan Allocations and Standards & Guidelines- Act as a liaison to the Forest planning team as final land allocations and resource management standards and guidelines are established for the Willamette National Forest. Communicate the Forest Plan progress to the District staff, employees and the local public.

Forest Plan Implementation- Develop resource action schedules based on the desired future conditions determined by the land allocations and public involvement. Develop position statements for resource projects to implement the Forest Plan that integrate sets of resource projects.

Forest Plan Monitoring- Utilize the data base to monitor the implementation of the Standards and Guidelines of the Forest Plan.

Organization

The Resource Information Systems team began forming in 1988 and was complete by March 1989. (Figure 4) The team leader is the Integrated Resource Analyst, an interdisciplinary GS-11 position. I supervise an Integrated Resource Planner, an interdisciplinary GS-9 position, with responsiblities in Forest Plan Implementation and Monitoring as well as geometronics. I also supervise a Special Projects Assistant (GS-5) and a Resource Data Manager (GS-7).

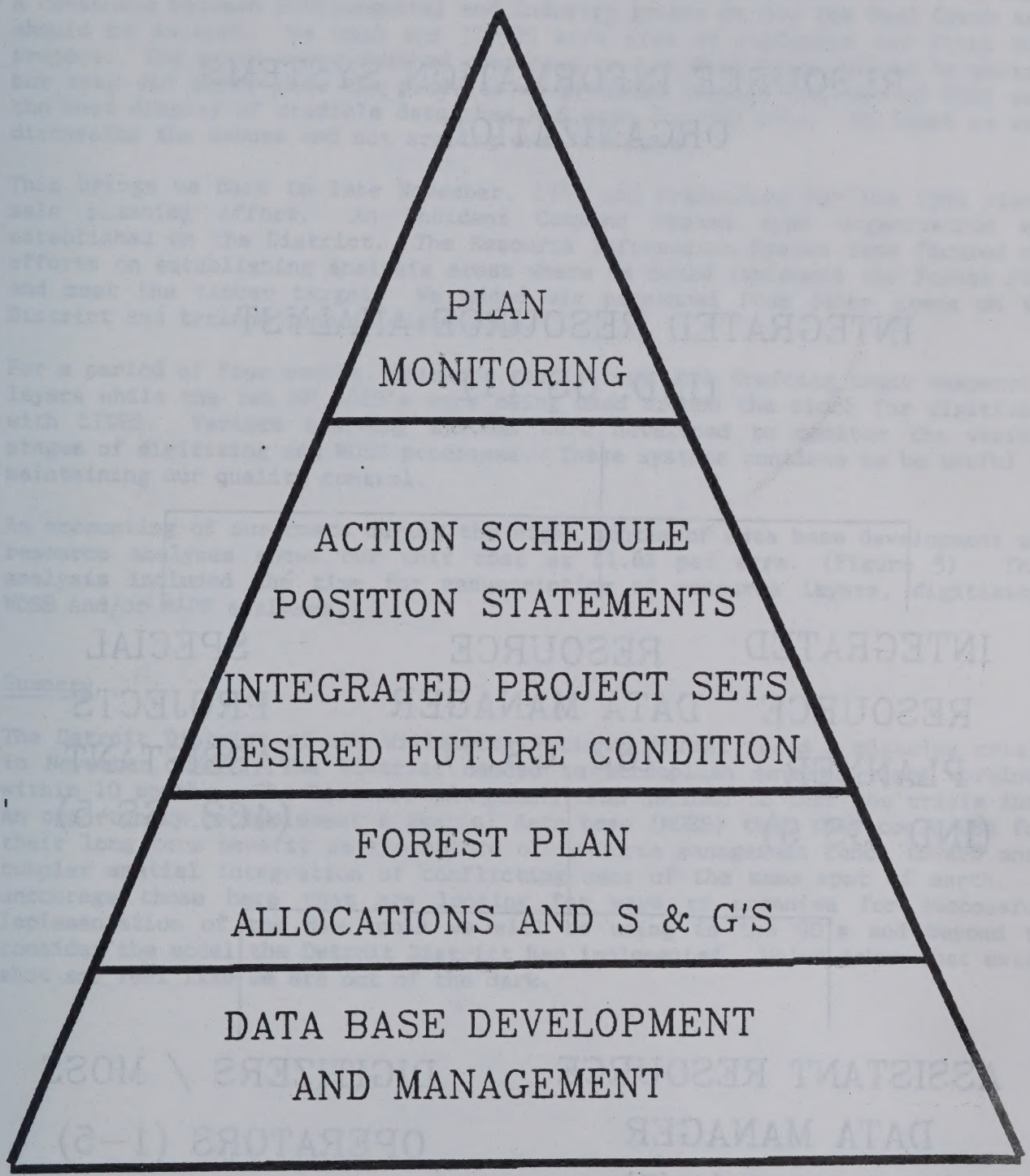
PLAN
MONITORING
ACTION SCHEDULE
POSITION STATEMENTS
INTEGRATED PROJECT SETS
DESIRED FUTURE CONDITION
FOREST PLAN
ALLOCATIONS AND S & G'S
DATA BASE DEVELOPMENT
AND MANAGEMENT
RESOURCE INFORMATION SYSTEMS

FIGURE 3:

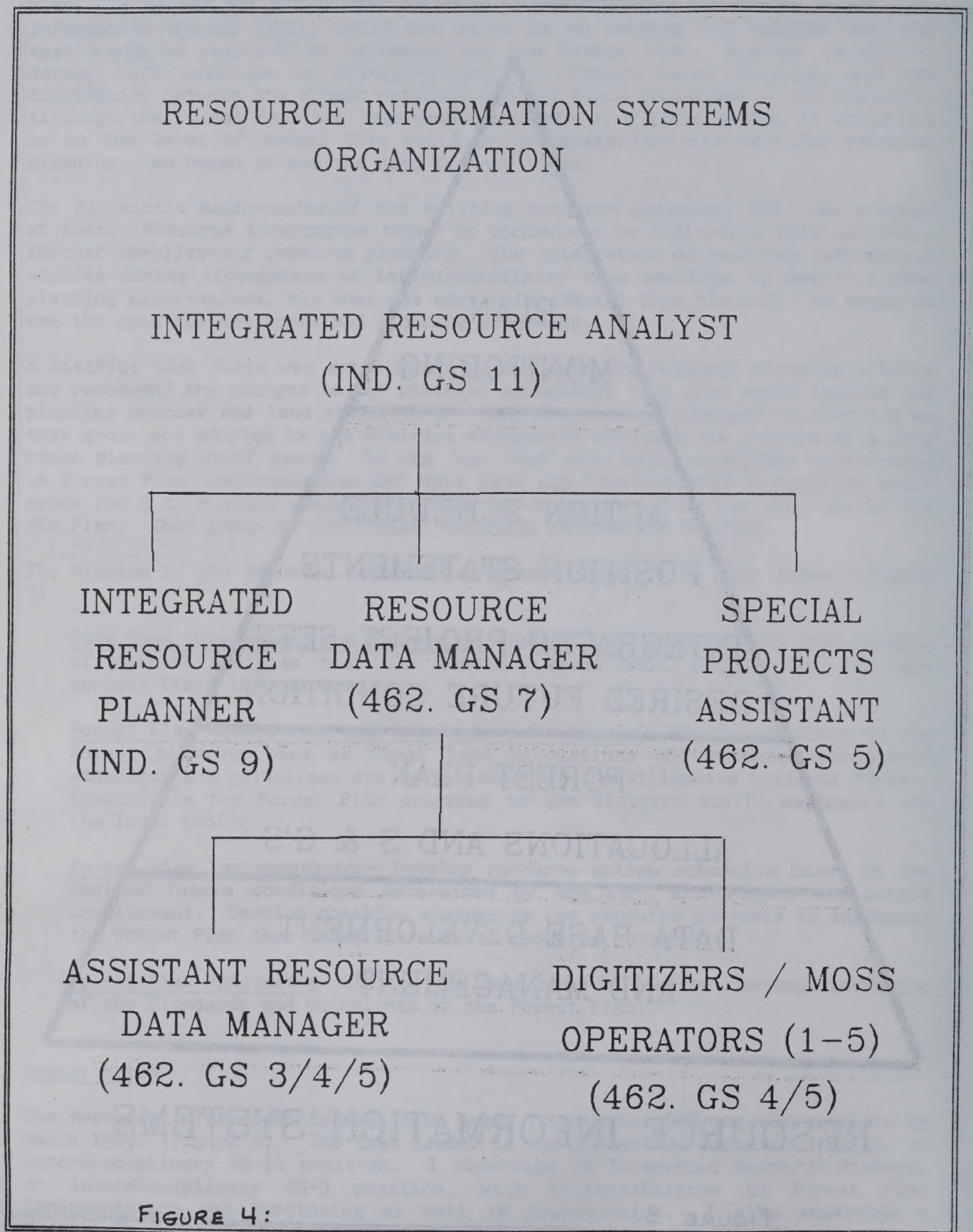
RESOURCE INFORMATION SYSTEMS
ORGANIZATION
INTEGRATED RESOURCE ANALYST
(IND. GS 11)
INTEGRATED RESOURCE PLANNER
(IND. GS 9)
RESOURCE DATA MANAGER
(462. GS 7)
SPECIAL PROJECTS ASSISTANT
(462. GS 5)
ASSISTANT RESOURCE DATA MANAGER
(462. GS 3/4/5)
DIGITIZERS / MOSS OPERATORS (1-5)
(462. GS 4/5)

FIGURE 4:

The Resource Data Manager's principal responsiblity is in data base management. The Resource Data Manager supervises an assistant (GS-3/4/5) and several GIS technicians.

One of our team's first projects was to assist in the District's effort to reach a consensus between environmental and industry groups on how the Opal Creek area should be managed. We used the 37,500 acre area to implement our first MOSS project. The group never reached consensus on how Opal Creek should be managed but they did agree that the products we produced through our use of MOSS were the best display of credible data they had seen for the area. At least we were discussing the issues and not arguing over the data.

This brings us back to late November, 1989 and organizing for the 1990 timber sale planning effort. An Incident Command System type organization was established on the District. The Resource Information System team focused our efforts on establishing analysis areas where we could implement the Forest Plan and meet the timber target. We added six personnel from other areas on the District and trained them in digitizing.

For a period of four months, resource specialists were drafting their respective layers while the two HP 9020's were being used around the clock for digitizing with LIDES. Various tracking systems were developed to monitor the various stages of digitizing and MOSS processes. These systems continue to be useful in maintaining our quality control.

An accounting of our costs during the eight months of data base development and resource analyses shows our unit cost at $1.61 per acre. (Figure 5) This analysis included the time for manuscripting of resource layers, digitizing, MOSS and/or MAPS analyses.

Summary

The Detroit District of the Willamette National Forest faced a planning crisis in November, 1989. The District needed to accomplish several years workload within 10 months. The District management team decided to turn the crisis into an opportunity to implement a spatial data base (MOSS) that they could use for their long term benefit as the nature of resource management tends toward more complex spatial integration of conflicting uses of the same spot of earth. I encourage those here that are looking for ways to organize for successful implementation of the new tools we will be using in the 90's and beyond to consider the model the Detroit District has implemented. We've taken that extra shot and feel like we are out of the dark.

FIGURE 5:

318 PROJECT COST
DETROIT RANGER DISTRICT

GIS RELATED COSTS:	M – $	M – HRS
EXTRA EQUIPMENT	5	–
LAYER MANUSCRIPT	36	3
DIGITIZE/ MOSS/ ANALYSIS	160	15
TOTAL:	201	18

OUTPUTS:	ACRES	MMBF
318 ANALYSIS AREAS	75,000	238
AREA IN GIS – NOT ANALYZED	50,000	
TOTAL:	125,000	

UNIT COST: $ 1.61 / ACRE

MAIDEN VOYAGE OF WODDB

Seventh National MOSS Users Conference
November 29, 1990 Portland, OR

By

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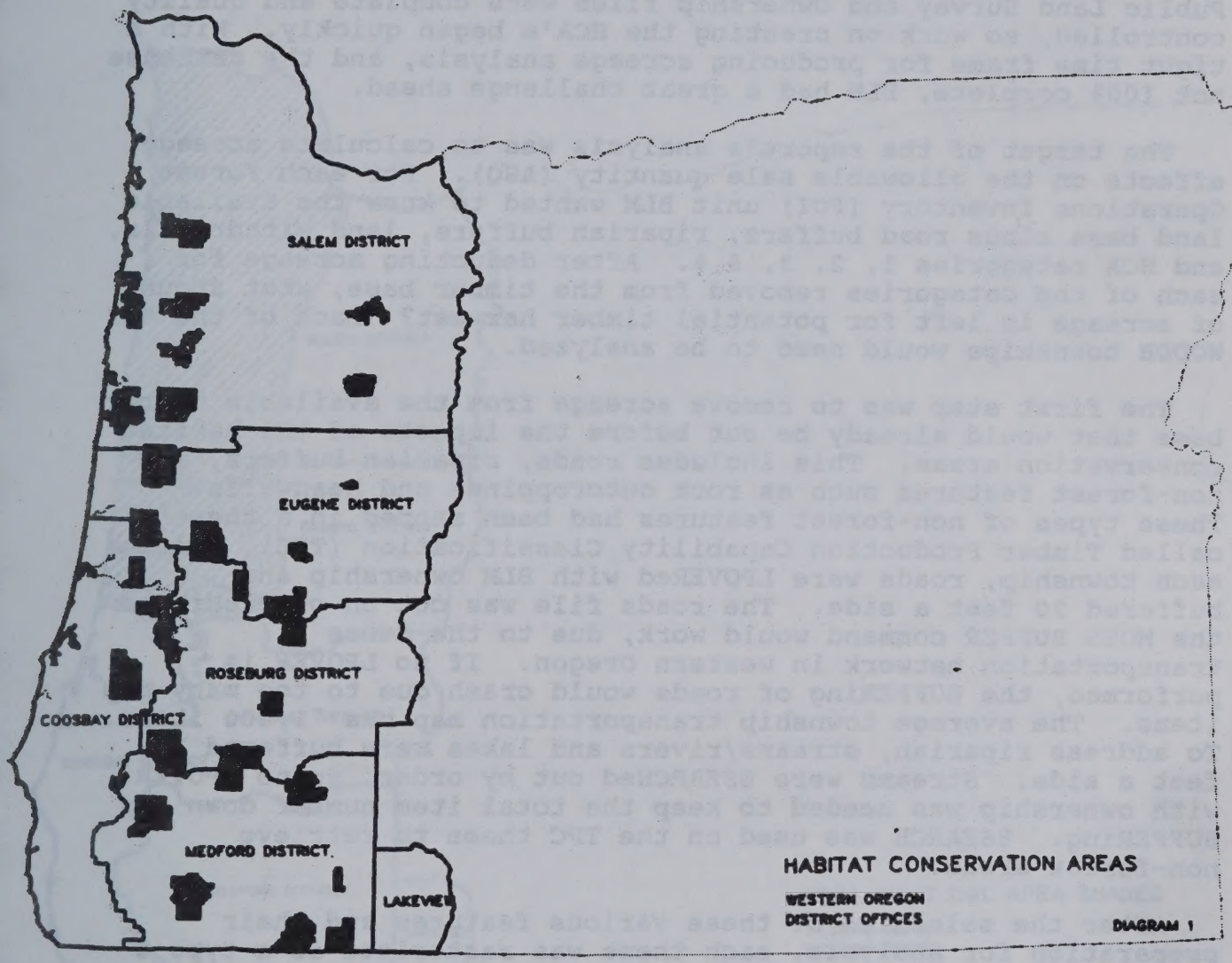
"MAIDEN VOYAGE OF WODDB"

This paper discusses the first large scale analysis project performed using the Western Oregon Digital Data Base (WODDB). The analysis was driven by the report "A Conservation Strategy for the Northern Spotted Owl", put together by the Interagency Scientific Committee to address the conservation of the Northern Spotted Owl. The release of this report in April 1990 set in motion an analysis by the Bureau of Land Management's (BLM) Oregon State Office to determine the effect of the strategy on current management activities.

BLM's Geographic Information System (GIS) database covers approximately 7 million acres of land within Western Oregon, of which 2.4 million acres is BLM-managed lands west of the Cascade mountain range. These are very productive lands for timber resources. The database was developed to assist the Bureau's 1990 Resource Management Plan (RMP) effort, and to monitor the plan throughout the next decade. The GIS database is supported by a Prime 6550 located in the State Office (SO), which is networked to the five western Oregon district office Prime 4150's. The database became an excellent tool to analyze the report's strategies.

Upon release of the Interagency Scientific Committee's report, new data had to be captured that represented large tracts of land to be unavailable for timber harvest to protect the future of the spotted owl. These defined blocks are called habitat conservation areas (HCA's) (see dia. 1) The large HCA blocks were designed for support of 20 or more owl pairs, or to sustain 2-19 pairs. The majority of these HCA's were defined by township section lines or ownership boundaries. To create this theme we used Public Land Survey and ownership data, which was at a scale of 1:12,000. Townships were merged together and section lines dissolved to create polygon HCA perimeters. These files were translated into the ADS file format, then closure/polygon routines performed to create the necessary polygon structure for MOSS.

Spotted owl pairs located outside of these HCA blocks would also receive habitat protection. Owl pairs within the region termed the "northwest owl area" (see dia. 2) were buffered 1.5 miles around the nest site. Owl pairs outside the HCA blocks, and not in the northwest owl area received a quarter mile buffer around the nest, of which the best habitat was removed from timber harvest. The last category in the strategy is called the 50-11-40 rule. For each quarter township, timber harvest would be permitted only when 50% of the forest landscape consists of stands with an average diameter at breast height (DBH) of eleven inches or more and a canopy closure of 40% or greater. To analyze the report's impact, WODDB was used for its first major project.

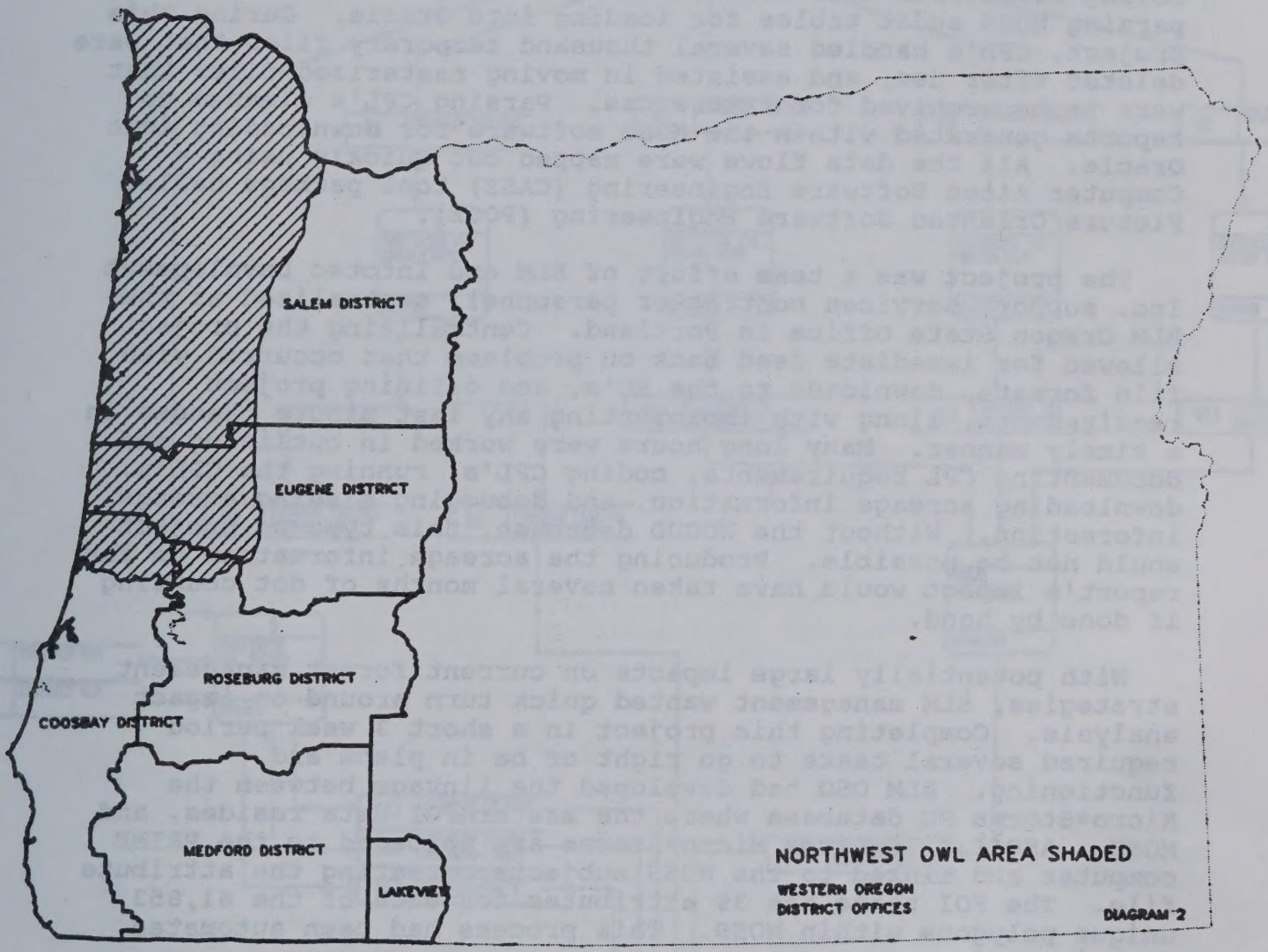

SALEM DISTRICT
EUGENE DISTRICT
ROSEBURG DISTRICT
COOSBAY DISTRICT
MEDFORD DISTRICT
LAKEVIEW
HABITAT CONSERVATION AREAS
WESTERN OREGON
DISTRICT OFFICES
DIAGRAM 1

The WODDB database was not fully functional at the report's release, as final quality control of several themes was in progress. Some themes remained to be linked to their multiple attribute files, and data had to be captured which delineated large habitat conservation areas detailed in the report. The Public Land Survey and Ownership files were complete and quality controlled, so work on creating the HCA's began quickly. With a tight time frame for producing acreage analysis, and the database not 100% complete, BLM had a great challenge ahead.

The target of the report's analysis was to calculate acreage effects on the allowable sale quantity (ASQ). For each Forest Operations Inventory (FOI) unit BLM wanted to know the available land base minus road buffers, riparian buffers, land withdrawals, and HCA categories 1, 2, 3, & 4. After deducting acreage for each of the categories removed from the timber base, what amount of acreage is left for potential timber harvest? Each of the 477 WODDB townships would need to be analyzed.

The first step was to remove acreage from the available timber base that would already be out before the impacts of the habitat conservation areas. This includes roads, riparian buffers, and non-forest features such as rock outcroppings and headwalls. These types of non-forest features had been mapped in a theme called Timber Production Capability Classification (TPC). For each township, roads were LPOVERed with BLM ownership and buffered 30 feet a side. The roads file was cut on ownership so the MOSS BUFFER command would work, due to the dense transportation network in western Oregon. If no LPOVER is performed, the BUFFERing of roads would crash due to too many map items. The average township transportation map has ~1,800 items. To address riparian, streams/rivers and lakes were buffered 75 feet a side. Streams were BSEARCHed out by order, so no LPOVER with ownership was needed to keep the total item number down for BUFFERing. BSEARCH was used on the TPC theme to retrieve non-forest areas.

After the selection of these various features and their preparation for analysis, each theme was rasterized as a type 6 dichotomous map. These files were merged together into one "out" map for each township. The full FOI theme was also rasterized as a type 6 dichotomous and type 7 discrete. The HCA's were at a district coverage in MOSS, so the appropriate township perimeter was windowed, then the HCA theme rasterized as a type 6 dichotomous and type 7 discrete. Next the FOI type 6 was booleaned with the HCA type 6, giving the FOI that remained outside HCA's.


SALEM DISTRICT
EUGENE DISTRICT
ROSEBURG DISTRICT
COOSBAY DISTRICT
MEDFORD DISTRICT
LAKEVIEW
NORTHWEST OWL AREA SHADED
WESTERN OREGON
DISTRICT OFFICES
DIAGRAM 2

To map out the complex analysis steps, data flow diagrams were constructed to show the logical flow of data and break downs of Command Procedure Language (CPL) modules written to perform analysis (see dia. 3). CPL's were written in a modular format for flexibility in use on other analysis projects. Modules were written to perform analysis steps such as buffering features, moving files from user directories to master archive areas, or parsing MOSS audit tables for loading into Oracle. During this project, CPL's handled several thousand temporary files that were deleted after use, and assisted in moving rasterized files that were to be archived for future use. Parsing CPL's cleaned up reports generated within the MOSS software for downloading into Oracle. All the data flows were mapped out quickly using a Computer Aided Software Engineering (CASE) tool package called Picture Oriented Software Engineering (POSE).

The project was a team effort of BLM and Infotec Development Inc. support services contractor personnel, centralized at the BLM Oregon State Office in Portland. Centralizing the project allowed for immediate feed back on problems that occurred with file formats, downloads to the PC's, and defining project requirements, along with implementing any last minute changes in a timely manner. Many long hours were worked in outlining and documenting CPL requirements, coding CPL's, running the CPL's, downloading acreage information, and debugging missing acreage information. Without the WODDB database, this type of project would not be possible. Producing the acreage information on the report's impact would have taken several months of dot counting if done by hand.

With potentially large impacts on current forest management strategies, BLM management wanted quick turn around on impact analysis. Completing this project in a short 3 week period required several tasks to go right or be in place and functioning. BLM OSO had developed the linkage between the Micro*Storms PC database where the master FOI data resides, and MOSS. ASCII files from Micro*Storms are uploaded to the PRIME computer and linked to the MOSS subjects, creating the attribute file. The FOI theme has 39 attributes for each of the 61,853 unique polygons within MOSS. This process had been automated back in 1988.

To return the remaining acreage for each FOI unit to Micro*Storms, COMO files of MOSS/MAPS area commands were edited to remove unnecessary data, such as headers and footers, leaving the MOSS subjects and acreage information. These data were loaded into Oracle tables, reformatted, then downloaded to Micro*Storms databases on PC's. With each timber stand having a unique identifier number, and the MOSS map having the same number for it's subject, there is a one to one correlation between MOSS/MAPS analysis and results being downloaded to the Micro*Storms relational database. Forest inventory specialists can see the impacts in their database, with analysis done by GIS.

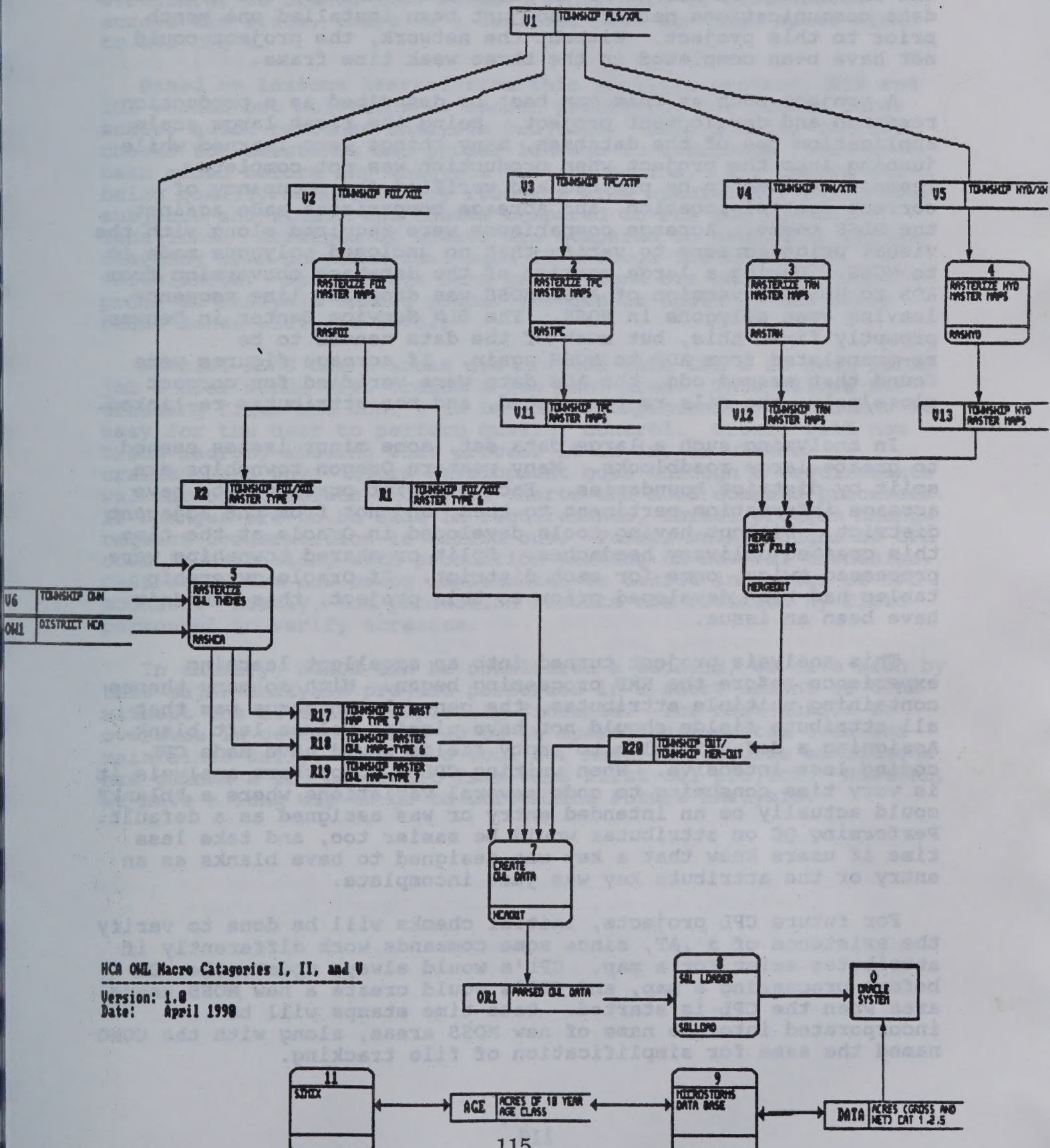

V1
TOWNSHIP FLS/XFL
V2
TOWNSHIP FOX/XXX
V3
TOWNSHIP TPC/XTP
V4
TOWNSHIP TRN/XTR
V5
TOWNSHIP HYD/XX
1
RASTERIZE FOX MASTER MAPS
RASFOX
2
RASTERIZE TPC MASTER MAPS
RASTPC
3
RASTERIZE TRN MASTER MAPS
RASTRN
4
RASTERIZE HYD MASTER MAPS
RASHYD
V11
TOWNSHIP TPC RASTER MAPS
V12
TOWNSHIP TRN RASTER MAPS
V13
TOWNSHIP HYD RASTER MAPS
R2
TOWNSHIP FOX/XXX RASTER TYPE 7
R1
TOWNSHIP FOX/XXX RASTER TYPE 6
6
MERGE CAT FILES
MERGECAT
V6
TOWNSHIP CAN
OA11
DISTRICT HCA
5
RASTERIZE CAL THEMES
RASHCA
R17
TOWNSHIP XX RAST MAP TYPE 7
R18
TOWNSHIP RASTER CAL MAPS-TYPE 6
R19
TOWNSHIP RASTER CAL MAP-TYPE 7
R20
TOWNSHIP CAT/ TOWNSHIP MER-CAT
7
CREATE CAL DATA
HCADAT
HCA CAL Macro Catagories I, II, and V
Version: 1.0
Date: April 1990
OR1
PARSED CAL DATA
8
SAL LOADER
SALLOAD
0
ORACLE SYSTEM
11
SIMIX
AGE
ACRES OF 10 YEAR AGE CLASS
9
MICROSTORMS DATA BASE
DATA
ACRES (GROSS AND NET) CAT 1,2,5

Diagram 3

With the database distributed across the district machines, the PRIME network had to be in place and running. The X.25 PRIME data communications network had just been installed one month prior to this project. Without the network, the project could not have been completed in the three week time frame.

A project such as this can best be described as a production research and development project. Being the first large scale application use of the database, many things were learned while jumping into the project when production was not complete. Themes remained to be plotted and verified for occupancy of correct spatial location, and acreage comparisons made against the PLSS theme. Acreage comparisons were required along with the visual print screens to verify that no unclosed polygons made it to MOSS. During a large portion of the database conversion from ADS to MOSS, a version of ADStoMOSS was dropping line segments, leaving open polygons in MOSS. The BLM Service Center in Denver promptly fixed this, but much of the data needed to be re-translated from ADS to MOSS again. If acreage figures were found that seemed odd, the ADS data were verified for correct close/poly, the file re-translated, and the attributes re-linked.

In analyzing such a large data set, some minor issues seemed to create large roadblocks. Many western Oregon townships are split by district boundaries. Each district preferred to have acreage information pertinent to them, and not from the adjacent district. Without having tools developed in Oracle at the time, this created delivery headaches. Split or shared townships were processed twice, once for each district. If Oracle ownership tables had been developed prior to this project, this wouldn't have been an issue.

This analysis project turned into an excellent learning experience before the RMP processing began. With so many themes containing multiple attributes, the general consensus was that all attribute fields should not have missing values left blank. Assigning a default value to empty fields would have made CPL coding less intensive. When writing CPL's to perform analysis it is very time consuming to code several variations where a "blank" could actually be an intended entry or was assigned as a default. Performing QC on attributes would be easier too, and take less time if users knew that a key was designed to have blanks as an entry or the attribute key was just incomplete.

For future CPL projects, initial checks will be done to verify the existence of a .AT, since some commands work differently if attributes exist for a map. CPL's would always update the .DT before processing a map, and CPL's would create a new MOSS users area when the CPL is started. Date time stamps will be incorporated into the name of new MOSS areas, along with the COMO named the same for simplification of file tracking.

With such a large database divided between so many MOSS projects, we will be looking at streamlining the file storage structure, to create less seams. Since data is distributed across the state, there is a definite need for high speed links to all CPU's.

Based on lessons learned from this analysis project, BLM and IDI worked out solutions to smooth processing for future large scale, quick response analysis projects. Data quality control checks for existence and proper linkage to attribute files have been added before any analysis project begins. All themes are being quality controlled by resource area specialists for proper subjects and items, and themes compared to PLS for spatial locations. Acreages of themes are compared to ownership files, flagging open polygons that made it through the ADS2MOSS translation. State Plane zone projections are checked by CPL's prior to analysis taking place. (Oregon is split by two state plane zones 5101 and 5076.)

Special MOSS users areas are created with CPL's so each batch job a user sends will create a new user area. This allows for tracking files and COMO's to be kept independently, and makes it easy for the user to perform quality control. Oracle will now track macros, showing what process it is in, or whether it crashed, and why. Macro development goes through a requirements walkthrough complete with flow charts and MOSS command processes. If changes are to be made in requirements, formal program change request documentation is filled out. Formal walkthroughs of CPL code is held along with production testing on several townships. CASE tools are now being implemented to assist in design of CPL modules. Lastly, the production results are reviewed by field personnel to verify acreages.

In summary, WODDB can be considered a success, we have seen by this major analysis project performed in a short amount of time without the database completely finished. The next hurdle to overcome is getting WODDB up to an operational system used and maintained daily. GIS as a tool for natural resource management has gained a lot of credit from this first owl project. However, we have a long way to go to streamline future analysis.

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Making Data Sharing a Reality

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Bureau of Land Management (WO-704)

It's a constant challenge to justify the funding for new computer systems in the Federal Government. One of the major benefits included in the benefit/cost analyses done for management and outside oversight agencies (like OMB and GAO) is data sharing. The benefits of automation are clearer when a proposed new system can eliminate duplicative data collection and produce reliable information.

This is easier said than done. The challenge is to make the data in a new automated system available - and consistently good - so other people will use the newly-automated files instead of their old cuff records. The "Not Invented Here" syndrome is as common among users of computer systems as it is in other activities. If the automated data is hard to access or unreliable, then others will reject it and the theoretical benefits of sharing the data will not become real.

A Data Catalog is a typical mechanism of alerting other potential users that you have already automated some data. The USGS and Department of Commerce have already published such catalogs, and they "market" their data extensively through them and other techniques. Such a catalog is a fundamental tool.

BLM currently has a minimal Data Catalog. Go to a Public Room in one of BLM's 12 State Offices and you'll find a list of items for sale. Typically they will include Master Title Plats, recreation maps, and other paper records that can be xeroxed or are already printed. Rarely will they include automated files, despite the agency's substantial investment to date in automating data about land parcels and the resources associated with them. In western Oregon BLM has invested nearly $14 million in the Western Oregon Digital Data Base (WODDB), but our warehouse of data has no retail outlet yet.

Building a comprehensive Data Catalog and institutionalizing the procedures for expanded data sharing will require some work; we can't just throw copies of the GIS themes into the Public Room. There are serious issues to resolve associated with data access and security, cost recovery, capacity planning for the computer system, and other management and technical concerns.

The good news is that the Forest Service, USGS, and BLM managers in Washington have agreed to work together in establishing common practices and procedures, and the field offices have already demonstrated initiative and creativity in sharing data. The common response to this news by field office people is that getting agreement in Washington is only the very beginning.

So how might BLM start? While the expanded data sharing program has not gone beyond the planning stage so far, you can anticipate pretty much a common sense process:

Inventory

To share data, BLM will need an inventory of what it has. A "records inventory" that includes not only case files in the dockets area but also maps, photographs, GIS themes, and other automated records would permit BLM to see what data has been collected and in what form. It's relevant to the user whether the information is automated or not, but both types should be inventoried.

Screen for Availability

A judgement call will be necessary to determine what data is available for sharing. BLM has just established three categories of data for public availability, and there is no point in trying to share data that is proprietary or subject to Privacy Act restrictions. Records administrators are essential players in this process.

Highlight Data of Interest

There's also little reason to focus on trying to share data that is of interest to only one BLM office. It makes more sense to use judgement - and a little research - to find those files in which there is a lot of interest from other Federal, State, or local agencies, interest groups, and the general public. Our "customers" are in touch with BLM offices regularly, especially in informal ways, trying to find information that has already been collected or automated.

Set Prices

It's tough now to figure out the ground rules of pricing automated data. OMB and Congress have been struggling with contrasting priorities. There's a desire to charge a high price for copies of automated files, to help repay the costs of the original collection and automation of the data. This is in conflict with the desire to set prices low, to expand the number of users of the data and to avoid duplication.

Tax dollars have been used to collect the data in BLM's offices, and copies of paper records are available for just the cost of duplication. The price of automated data may end up being equal to the costs of duplicating a tape or disk, rather than reflecting the market value of the data. However, at this time there are no standard BLM prices for the GIS themes and standardized prices will be hard to establish for products from our Prime computer platform.

Market the Data

BLM will never equal Budweiser in advertising and there is no need to broadcast the BLM Data Catalog to uninterested audiences. BLM will identify possible "customers" and focus its communications to them, especially emphasizing the data that has already been automated by BLM. After all, if BLM keeps products like ALMRS or WODDB files hidden under a bushel, other agencies will not know that they are duplicating efforts when they build similar data bases.

However, data "marketing" by BLM will be limited to just the data that BLM will collect to meet BLM needs. BLM won't become an organization that tries to market economic data or to collect data just because someone else wants it. Data sharing is a spin-off of land management, not an end in itself.

Operations and Maintenance

The investments in GIS and ALMRS are long-term efforts that have required years of records improvement and data automation. With the advantage of 20-20 hindsight we can now see that choosing the hardware and software is a relatively small challenge compared to data management. If BLM automates data without reliable standards, there will be little benefit in processing it faster or in sharing it with others.

The operations and maintenance of the Data Catalog will be a small part of the ongoing records and data administration program. Once the investment has been made in developing automated files that meet BLM's standards, the benefits of data sharing can be obtained over many years.

As BLM updates its files and maintains their value, the benefits of data sharing can continue past the life cycle of hardware and software. BLM is using data that is over 200 years old in the Cadastral Survey program and for resolving old land claims.

Expansion

BLM has learned to start small and to build automated systems in increments, step by step. Only after getting a part of the Data Catalog completed, tested, and operational will BLM expand it. Though the BLM records inventory will include only data BLM needs for its mission, it will still include many files not appropriate for the Data Catalog. After the initial start up of the data sharing program, its expansion (and the size of the Data Catalog) will be based primarily on the interest of the customers.

As mentioned before, the BLM data sharing program is not new but is still very small compared to the size projected in the benefit/cost analyses. Planning for the future requires assessing the probable policy constraints and management priorities that will affect the program.

If we were to look through a crystal ball, we can project the following:

In all Federal agencies justifying funding to the Congress, times will stay hard and customer service will win friends and influence people.

- OMB and Congressional direction will stay incomplete and even contradictory, so case law and precedents will provide the fundamental guidance and BLM personnel will have to fill in the rest and see what happens if the case is taken to court.

- Freedom of Information Act exemptions will haunt efforts to run smooth, standard operations. Records management people will be elevated in importance as demand for data increases and the complexity of the issues requires more management attention.

- Data standards exceptions and inconsistencies will haunt efforts to run smooth, standard operations. Data administration personnel will be elevated in importance...

- Security and access issues will haunt efforts to run smooth, standard operations. IRM personnel, including records and data administrators, will be elevated in importance...

- Managers will be confused and frustrated by all these new issues and the complexity associated with data sharing. What should seem such a simple process of copying a tape will have all these peculiarities that will, to some managers, look like empire building by the IRM program.

- Over time, some standard products will evolve and require minimal effort to provide. The current Public Room list is a likely place to start, with Master Title Plats. Some of the easiest files to provide will be Digital Line Graphs (DLG's) and basic automated resource data themes used in every BLM office for land use plans.

- Not everyone will automate, and paper will always be a lowest common denominator format for data sharing.

- Standard prices will not exceed the perceived market value of the file, no matter what the cost recovery formula may require. Do not expect a fully rational program, but where the rules don't make sense we'll make exceptions to the rule. Look at the exceptions and different pricing schemes in the recreation permit and rights of way program as a model.

- Public Rooms may evolve into Information Centers, but they will never become profit centers. Think of them more as libraries rather than as investor owned utilities, with their purpose being to minimize costs rather than earn a profit.

CONVERSION OF AN ARC/INFO COVERAGE CONTAINING MULTIPLE ATTRIBUTE DATA TO A MOSS MULTIPLE ATTRIBUTE DATA BASE

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ABSTRACT

Data exchange programs between government agencies provide an effective way of reducing redundancy of data entry and thereby reducing the overall cost of data capture. In addition to common data formats, data conversion programs are commonly used as a method by which data of interest to two or more agencies can be shared. Individual geographic information system format differences however, sometimes prevent complete utilization of shared data sets. ARC/INFO Version 5.0 supports a conversion program (ARCMOSS) allowing for the conversion of ARC/INFO coverages to MOSS data bases. The ARCMOSS program takes into account the thirty character limit for MOSS subjects and truncates the ARC/INFO attribute accordingly. As a result, critical information contained in the ARC/INFO coverage, which is not limited to thirty character attribute strings, is lost during the conversion process. A technique was developed whereby the complete ARC attributes can be transferred to a MOSS data base by utilizing MOSS's multiple attribute capabilities. ARC attributes greater than thirty characters, as well as the INFO relational database files can be ported to MOSS without losing any critical attribute information. This technique will allow MOSS users to take complete advantage of existing ARC coverages developed by other agencies, and therefore contribute to the sharing of data between agencies using different geographic information systems.

INTRODUCTION

Anadromous fisheries in the State of Alaska are extremely important to the well being of local, commercial, and recreational fishing industries, and exert significant influence on the local and state

- States will establish data sharing centers, like the Teale Data Center in California, for distributing GIS themes among State agencies. BLM will be able to provide these state data centers with a copy of its data and most (but not all) state agencies will get their copies from there, rather than directly from BLM.

- BLM will not be able to control the recopying and further distribution of its data by these State data centers. They will provide further distribution to local agencies, interest groups, and the general public) which will save BLM some costs and still generate extensive benefits by eliminating duplicative data automation.

- Basic map data, like the layers on the USGS quad maps, will not be updated often. Once an organization acquires a copy, they'll reuse it often. Other layers, like land status or oil and gas well locations, will have a shorter lifespan and will be updated regularly. BLM will have a constant demand for these items and may provide subscriptions to regular customers, similar to the way magazines are sold. As a result, BLM will be able to ensure partial quality control for those layers because major customers will recognize that they will become outdated.

- Much data will be copied and recopied without attribution to the source agency, the map scale, the data of original acquisition, or other fundamental "metadata". No matter how hard agencies try to ensure accuracy of their data, infrequent users will often be working from outdated files and challenging BLM decisions with old information.

- Cost recovery will always be a political issue. Once the interest groups and other users of BLM data band together to ensure easy access and low prices, their support will be a two)edged sword. They will provide continuing support and justification for continued investment in new automated capabilities, but will also limit the opportunity to recover the full range of costs.

- Career opportunities will open up dramatically for data/records managers, particularly for the transition to electronic records. The traditional, almost stodgy image of clerks and computer specialists will deter some people from moving into these jobs. However, early risk takers with a resource management background will find clear opportunities for advancement and management attention.

economies. Protection and enhancement of the anadromous fisheries in the Alaskan Pacific Coast drainages are therefore critically important to the maintenance of the resource and to the economic stability of the local communities and commercial fishing industry. Both the Bureau of Land Management (BLM) and the State of Alaska, Department of Fish and Game (ADF&G) share in the responsibilities of the management, protection and enhancement of this valuable resource. Although mutually responsible for this resource, each agency has its own independent goals and objectives; each agency has unique responsibilities associated with this resource; and each agency has developed its own approaches to satisfying these responsibilities utilizing information management technologies, including geographic information system capabilities.

The BLM's Anchorage District Office, is responsible for the management of the resources which occur on Alaska's public lands. With respect to the anadromous fisheries, the Anchorage District Office has the following goals and objectives: (1) to identify the streams that support anadromous fish; (2) increase habitat productivity in streams currently utilized by anadromous fish but with production lower than potential; (3) increase the available habitat for anadromous fish production; and (4) develop interagency habitat management plans for watersheds supporting anadromous fish populations. In order to meet these goals and objectives, an accurate inventory of streams and an understanding of their respective relationships with anadromous fish species was required. Based upon the total number of streams involved, the number of fish species, and the complex relationships between anadromous fish and their habitats, the BLM was faced with a formidable task. The utilization of the BLM's Map Overlay and Statistical System provided a mechanism by which BLM could apply geographic information system technology to support their inventory and related requirements.

Concurrent with the BLM responsibilities, the ADF&G was also tasked with the protection of anadromous fisheries. Since 1982, ADF&G has intensively surveyed Alaskan waters to identify and catalog waters which are important for spawning, rearing, and migration of anadromous fisheries. In addition, ADF&G is in the process of developing a permit process for the protection of anadromous fish habitat as legislated under state law (AS 16.05.840, AS 16.05.870, AS 16.20.060, AS 16.20.260 and any activity authorized under AS 16). ADF&G also utilizes geographic information system technology, including the ARC/INFO system, to support their data inventory and analysis requirements.

The shared responsibilities with respect to the protection of anadromous fisheries, and the similarities in which each agency technically approached meeting their goals and objectives, resulted in an ideal situation in which both agencies could benefit from information the other agency had developed. A cooperative agreement was therefore established between ADF&G and BLM which provided BLM access to critical anadromous fisheries information being collected by

ADF&G in exchange for any digital information BLM developed with respect to the geographic description of the relevant water courses. However, due to the fact that the two agencies utilized two unique geographic information systems (ie. ARC/INFO and MOSS), it was necessary to develop a conversion methodology in order to provide complete sets of information to both agencies in formats which were compatible with each agency's respective system.

The successful conversion required technical expertise in both ARC/INFO and MOSS, utilizing the data base management capability of INFO, and the multiple attribute capability of MOSS. Under BLM's contract YA-551-CT5-440003 for digitizing services, TGS Technology, Inc.'s Computer Mapping Division in Fort Collins, Colorado, had supported BLM's digitizing and MOSS data base construction requirements for several years. As a commercial data conversion service bureau, TGS's Computer Mapping Division also supports map conversion using the ARC/INFO system. Using that expertise, TGS developed the necessary technical and quality control procedures required to combine information from both agencies into two seperate, but functionally identical data bases which can now be used by both agencies in supporting their mission requirements.

METHODOLOGY

The source data included digital data files of hydrologic features in ARC/INFO format, as captured by a combination of scanning and hand digitizing, and provided by the Anchorage District Office. In addition to the digital files, hard copy maps annotated with stream codes and descriptive information concerning the anadromous fisheries associations were provide by ADF&G. ADF&G also provided the relevant publications "Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes", which describes each anadromous stream segment by number.

The digital data were provided as individual ARC coverages of 1:63,360-scale quadrangles in ARC EXPORT format. Approximately 140 quadrangles were processed. These data were loaded onto a Prime 4150, IMPORTED into ARC/INFO (Rev. 5.0) and displayed. The first phase of the project was to edge match all quadrangles to produce a continuous data base. After edgematching, each arc representative of an anadromous stream segment was coded with the ADF&G stream code value (Table 1). The development of the stream code is adequately described in the referenced ADF&G publication. Briefly, the stream code numerically defines the ADF&G statistical fishing district for the body of saltwater into which the stream flows, stream order value, and any lake associations.

Table 1 - ARC Coverage Format

FNODE	TNODE	LPOLY	RPOLY	LENGTH	User-ID#	STREAM CODE
1	2	0	0	1.4	1	335-20-16600-2741-3107

The descriptive information contained on the maps included the map name, stream name, list of species utilizing each stream segment, and the function which the stream supported (ie. migration, spawning, rearing). These data were entered into an INFO file, such that each field contained a specific attribute. Included in the INFO file was the stream code which was also associated with each stream segment in the ARC coverage (Table 2).

Table 2 - INFO File Format

STREAM CODE	MAP NAME	STREAM NAME	SPECIES	USEAGE
335-20-16600-2741-3107	Iditarod A-4	N. Fork George River	K	R

The stream code then was used to relate the ARC coverage to the INFO file, completing the ARC data processing requirement and resulting in a comprehensive ARC/INFO data base describing the anadromous fisheries. This data base was provided to the ADF&G.

To meet BLM requirements, the ARC/INFO coverage was then converted into a MOSS data base. In the ARC/INFO data base, the number of characters used to describe the each stream and associated fisheries data exceeded the thirty character limitation for a MOSS attribute. As a result, the multiple attribute capability of MOSS was utilized. The following steps were required to complete this portion of the conversion effort.

ARC coverages were first exported using the ARCMOSS command, which creates a MOSS IMPORT data set. This function requires that the data be in either the UTM projection or in geographic (ie. latitude, longitude) format. Secondly, one item from the ARC coverage must be redefined as the MOSS subject. Choices for the MOSS subject include the ARC coverage user-ID or associated attribute, that being the stream code. Since there may be two individual stream segments with identical stream codes, the unique ARC user-ID was used as the MOSS subject. The

resultant file is then imported into MOSS with the number of MOSS subjects equal to the number of ARC coverage user-ID's (Table 3).

Table 3 - MOSS Map Format

ITEM #	SUBJECT
1	1

This completes the conversion of the stream segments from ARC/INFO to MOSS. The next step is to convert the INFO data base into a MOSS multiple attribute file.

The INFO file was accessed in the ARC/INFO system and SAVED to seperate ASCII disk file using the compress option. Similar to the ARC/INFO requirement that a common denominator be used to relate the ARC coverage to the INFO file, MOSS also requires a common denominator to allow for the association between the MOSS map and the MOSS multiple attribute file. The MOSS subject, derived from the ARC user-ID, provided this association. However, the MOSS map subject is defined as a character string, and therefore the equivalent value in the MOSS multiple attribute file must also be defined as a character string. Since this information is extracted from the INFO file, where the user-ID is an integer, a conflict occurs. The right justified integer value from INFO will not automatically translate into a left justified character string. A secondary program was developed which provided the capability to make this translation successful. Once completed, the map was then moved into the MOSS user area (Table 4).

Table 4 - MOSS Multiple Attribute File Format

SUBJECT	STREAM CODE	MAP NAME	STREAM NAME	SPECIES	USEAGE
1	335-20-16600-2741-3107	Iditarod A-4	N. Fork George River	K	R

Another important difference exists between the INFO data base and the MOSS multiple attribute data base. In the ARC coverage, stream segments which are not utilized by anadromous fisheries are not described in the INFO file. In the MOSS multiple attribute file however, each feature (subject) in the MOSS map must be accounted for in the multiple attribute file, regardless of whether or not it has anadromous fishery information associated with it. To resolve this

difference, the MOSS utility RESEQUENCE command is executed on the converted INFO file. The RESEQUENCE function adds appropriate records to the multiple attribute table for those MOSS map features which do not have anadromous fishery associations (Table 5).

Table 5 - MOSS Multiple Attribute File Format - RESEQUENCED

SUBJECT	STREAM CODE	MAP NAME	STREAM NAME	SPECIES	USEAGE
1	335-20-16600-2741-3107	Iditarod A-4	N. Fork George River	K	R
2	335-20-16600-2741	Iditarod A-4	N. Fork George River	CH-CO-K-W	S-S-S-M
3					
4					
5	335-20-16600-2741-3091	Iditarod A-4	N. Fork George River	K	R

The MOSS utility function, ATTRIBUTE DESCRIBE, was then used to create a .DESCRIBE file, which defines the MOSS multiple attribute field formats. These field formats are identical to the INFO field format specifications. The MOSS ADD.ATTRIBUTE function was then executed to establish the relationship between the MOSS map and the MOSS multiple attribute table. This final step completed the conversion process, and resulted in a MOSS map which provides the user with complete data for each feature. The resultant MOSS data bases were then provided to BLM for their anadromous fishery management requirements.

CONCLUSION

The ability to convert data from one geographic information system to another provides a mechanism by which data can be shared by multiple agencies. Using standard system functions, and a minimal amount of specialized programming, valuable anadromous fisheries data are being shared between the State of Alaska and the Bureau of Land Management. Sharing these data gives both agencies equivalent data bases which they can now apply independently to each of their respective missions. Sharing data in this manner has enhanced the ability of both agencies to meet their program goals and objectives, and eliminated the potential duplication of effort which would have occurred if they pursued these efforts independently.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the technical assistance of Mr. Mike Scott, BLM, Anchorage District Office, in providing accurate digital stream data, and in providing coordination between BLM, ADF&G, and TGS Technology, Inc. for this project.

APPENDIX

The following pages document the MOSS work sessions used in the development of the MOSS map and multiple attribute data base described in this paper. The example map was Iditarod A-4 and was one of the maps processed for this project. The authors hope that this example will allow other MOSS users to become familiar with the procedures, and promote the efforts by MOSS users to take advantage of existing ARC/INFO data sources which may be available through other agencies.

Appendix Exhibit 1 - IMPORT COMO

FUNCTION - Imports the ARC coverage into MOSS.

```
OK, MOSS AKHYDRO KEITH


OK, MOSS AKHYDRO KEITH

            MAP OVERLAY AND STATISTICAL SYSTEM
            *8908 32 BIT RELEASE* W/9001 PATCH

 PRIMOS version 22.0.1.DOI / F77 Rev. T1.3-21.0 REQUIRED
   "NEWS" COMMAND PROVIDES CURRENT SYSTEM INFORMATION

  IF YOU HAVE ANY PROBLEMS, CALL YOUR STATE GIS OFFICE
  IN EMERGENCIES   CALL THE GIS HOTLINE:  (FTS) 776-0990
                                          (303) 236-0990


AKHYDRO is a valid MOSS MASTER PROJECT.

    ***********************************
   *          FIELD VERSION            *
  *  32 BIT MOSS FOR PRIMOS  22.1.DOI   *
  *  Use only the 32 Bit 89.08 Manual   *
   *          *8908* 1/25/90           *
    ***********************************

ENTER COMMAND ? IMPORT
Input file name -
IDA4 EXP
 What do you wish to call the new map ?
  ---------
  IDA4
 Enter NAME of map to use as a template for the new map header
 or enter CARRIAGE RETURN to start map header from scratch


 ENTER SOURCE OF MAP  [                    ]
TGS/CMD
 ENTER  CREATION DATE  [         ]
1990
 ENTER  STUDYAREA NAME [         ]
  AKHYDRO
 ENTER  DESCRIPTION
 [                                                                    ]
 ------------------------------------------------------------------------
HYDROLOGY ON ALASKA'S IDITAROD A4
 ENTER  MAP VINTAGE  [     ]
  1989
 ENTER NUMBER OF SUBJECTS [     1]
  350
 ENTER COORDINATE SCALE FACTOR [     100.0000]


         MAP PROJECTION


   # 0 PROJECTION IS GEOGRAPHIC(LON/LAT)
       COORDINATE UNITS ARE:  DEGREES

 DO YOU WISH TO CHANGE THE PROJECTION DESCRIPTION [N]
  Y
```

```
OK/ MOSS AKHYDRO KEITH


 ELLIPSOID (0-19)
 LONGITUDE OF ANY POINT WITHIN THE UTM ZONE ?
-157 00 00
 LATITUDE OF ANY POINT WITHIN UTM ZONE    4 ?
62 00 00

 IS THIS HEADER INFORMATION CORRECT [Y]
  Y
   ENTER DATATYPE

   1 = POINT                          11 = (X,Y,Z) POINT
   2 = LINE                           12 = (X,Y,Z) LINE
   3 = POLYGON                        13 = (X,Y,Z) POLYGON
   5 = SAMPLE ELEVATION POINT
  2

 EXECUTING . PLEASE WAIT

 IMPORT COMPLETE FOR THE NEW MAP: IDA4
   306 ITEMS AND   306 SUBJECTS IN THE NEW MAP

 THE INPUT FILE IS IDA4.EXP
 DO YOU WISH TO DELETE THE INPUT FILE  [N]
  N
**** STOP

ENTER COMMAND ? BYE

  USER KEITH  EXITING MOSS
**** STOP
```

Appendix Exhibit 2 - RESEQUENCE COMO

FUNCTION - Resequences the converted INFO file to add non-anadromous hydrological features to the MOSS multiple attribute file, which were not included in the INFO file.

```
OK, MOSS AKHYDRO KEITH


 ENTER THE SOURCE OF ORDER FOR THE ATTRIBUTE FILE
  1 = Exit [Default]
  2 = Map  IDA4
  3 = File IDA4.OUT
: 2
 Enter name of data file to be resequenced:
IDA4.FISH
 Enter START and STOP column positions (START# STOP#)
 of the matching subject field in the data file
48,51
 Enter SUBJECT search start position [1]
: 1
 RESEQUENCING, PLEASE WAIT...
 COULD NOT FIND SUBJECT 1 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 2 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 3 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 4 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 5 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 6 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 7 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 8 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 9 IN DATA FILE - WRITING A BLANK RECORD
 COULD NOT FIND SUBJECT 10 IN DATA FILE - WRITING A BLANK RECORD
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OK, MOSS AKHYDRO KEITH

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OK, MOSS AKHYDRO ^EITH

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COULD NOT FIND SUBJECT 300 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 301 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 302 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 303 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 304 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 305 IN DATA FILE - WRITING A BLANK RECORD
COULD NOT FIND SUBJECT 306 IN DATA FILE - WRITING A BLANK RECORD

THE NAME OF YOUR RESEQUENCED DATA FILE IS:  IDA4.FISH.RES
```

```
OK, MOSS AKHYDRO KEITH


 THE NUMBER OF ATTRIBUTES IS      7
 THE NUMBER OF ITEMS IS         306

 PLEASE ENTER DESIRED OPTION
  1  =  EXIT   [DEFAULT]
  2  =  ADD A NEW ATTRIBUTE
  3  =  UPDATE AN EXISTING ATTRIBUTE
  4  =  CHANGE/DELETE KEY OR DESCRIPTOR
  5  =  LIST ATTRIBUTE FIELDS
  6  =  SEARCH AN ATTRIBUTE FIELD
  7  =  RESEQUENCE INPUT DATA FILE
  8  =  DELETE THE ATTRIBUTE FILE
: 1
**** STOP


 ENTER MOSS UTILITY OPTION
   1  =  TERMINATE UTILITY SESSION   [DEFAULT]
   2  =  DATABTEST    (MOSS MAP NAMES SUPPORT)
   3  =  ATTRIBUTE    (MOSS MULTIPLE ATTRIBUTE SUPPORT)
   4  =  ATTDES       (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
   5  =  SUB2AT       (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
   6  =  APROJ        (MOSS MAP NAMES PROJECTION ASSIGNMENT)
   7  =  BROWZ        (MOSS MAP NAMES HEADER LISTING)
   8  =  PLOT.LEGEND  (BUILD PLOTTER LEGEND FILE)
   9  =  MAKE.LOGO    (BUILD PLOTTER LOGO FILE)
  10  =  SUBEDIT      (MAP SUBJECT EDIT PROGRAM)
  11  =  SET.LEVEL    (BUILD POLYCELL TRANSLATION FILE)
  12  =  TRANSFORM    (TRANSFORM COORDINATES TO A PROJECTION)
  13  =  QUAD         (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
  14  =  DLG3         (USGS DLG ASCII TO MOSS)
  15  =  MAPIDX       (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
  16  =  XYSUBJECT    (REFORMAT POINT DATA TO MOSS)
  17  =  ATT2SUB      (ATTRIBUTE TO SUBJECT)
: 1

  MOSS UTILITY SESSION COMPLETED


ENTER COMMAND ? BYE

  USER KEITH  EXITING MOSS
**** STOP
```

Appendix Exhibit 3 - RESEQUENCE OUTPUT

FUNCTION - Output file resulting from the RESEQUENCE program.

(Note: Due to the paper width limitation, each record wraps around to the next line.)

		61		
		62		
		63		
		64		
		65		
		66		
		67		
		68		
		69		
		70		
		71		
		72		
		73		
		74		
		75		
		76		
		77		
		78		
		79		
		80		
		81		
335-20-16600-2741-3121		82	K	ONTS
	R	IDA4		
		83		
		84		
		85		
		86		
		87		
		88		
335-20-16600-2741		89 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741		90 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		91		
		92		
		93		
		94		
335-20-16600-2741		95 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		96		
		97		
		98		
		99		
		100		
		101		
335-20-16600-2741		102 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741		103 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		104		
		105		
		106		
		107		
		108		
		109		
335-20-16600-2741		110 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		111		
335-20-16600-2741		112 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR

113				
114				
335-20-16600-2741		115 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
116				
335-20-16600-2741		117 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741-3107		118	K	ONTS
	R	IDA4		
335-20-16600-2741		119 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
120				
121				
335-20-16600-2741		122 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741-3107		123	K	ONTS
	R	IDA4		
124				
125				
126				
335-20-16600-2741		127 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
128				
335-20-16600-2741		129 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
130				
131				
335-20-16600-2741		132 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
133				
134				
135				
335-20-16600-2741-3101		136	K	ONTS
	R	IDA4		
335-20-16600-2741-3101		137	K	ONTS
	R	IDA4		
335-20-16600-2741		138 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741-3101		139	K	ONTS
	R	IDA4		
335-20-16600-2741		140 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
141				
142				
335-20-16600-2741		143 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
144				
145				
146				
335-20-16600-2741-3075		147 NORTH FORK GEORGE RIVER	K	ONTS
	R	IDA4		
335-20-16600-2741-3075-4077		148	K	ONTS
	R	IDA4		
149				
150				
335-20-16600-2741		151 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
152				
153				
154				

		155		
335-20-16600-2741-3091		156 GEORGE RIVER	K	ONTS
	R	IDA4		
335-20-16600-2741-3091-4011		157	K	ONTS
	R	IDA4		
		158		
		159		
		160		
335-20-16600-2741-3091		161	K	ONTS
	R	IDA4		
335-20-16600-2741-3091		162	K	ONTS
	R	IDA4		
		163		
335-20-16600-2741		164 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		165		
		166		
		167		
335-20-16600-2741		168 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741		169 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		170		
335-20-16600-2741		171 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		172		
		173		
		174		
		175		
		176		
		177		
		178		
		179		
335-20-16600-2741		180 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
335-20-16600-2741-3075		181 NORTH FORK GEORGE RIVER	K	ONTS
	R	IDA4		
335-20-16600-2741		182 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		183		
		184		
335-20-16600-2741-3075-4060		185	K	ONTS
	R	IDA4		
		186		
		187		
335-20-16600-2741-3075		188 NORTH FORK GEORGE RIVER	K	ONTS
	R	IDA4		
335-20-16600-2741-3081-4020		189	K	ONTS
	R	IDA4		
		190		
		191		
		192		
		193		
335-20-16600-2741-3075		194 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M	IDA4		
		195		
		196		
335-20-16600-2741-3075		197 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR

			199		
			200		
			201		
335-20-16600-2741-3081			202	K	ONTS
	R		IDA4		
			203		
			204		
335-20-16600-2741-3075-4054			205	K	ONTS
	R		IDA4		
335-20-16600-2741-3075			206 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20-16600-2741-3075			207 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20-16600-2741-3075			208 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20-16600-2741			209 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M		IDA4		
			210		
			211		
335-20-16600-2741-3075			212 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20-16600-2741			213 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M		IDA4		
			214		
335-20-16600-2741-3081			215	K	ONTS
	R		IDA4		
			216		
			217		
			218		
			219		
335-20-16600-2741-3075-4065			220	K	ONTS
	R		IDA4		
335-20-16600-2741-3075			221 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20-16600-2741-3081			222	K	ONTS
	R		IDA4		
			223		
335-20-16600-2741			224 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M		IDA4		
			225		
			226		
335-20-16600-2741			227 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M		IDA4		
			228		
			229		
			230		
335-20 16600-2741-3075			231 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20 16600-2741-3075			232 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
335-20 16600-2741-3075			233 NORTH FORK GEORGE RIVER	CH-K-W	ONKE-ONTS-PR
	M-M-M		IDA4		
			234		
			235		
335-20 16600-2741-3075-4091			236	K	ONTS
	R		IDA4		
			237		
			238		
			239		

241				
335-20-16600-2741	S-S-S-M	242 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
243				
244				
335-20-16600-2741	S-S-S-M	245 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
246				
335-20-16600-2741-3075	M-M-M	247 NORTH FORK GEORGE RIVER IDA4	CH-K-W	ONKE-ONTS-PR
335-20-16600-2741	S-S-S-M	248 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
249				
250				
335-20-16600-2741	S-S-S-M	251 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
252				
335-20-16600-2741	S-S-S-M	253 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741	S-S-S-M	254 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741-3070	R	255 IDA4	K	ONTS
256				
257				
335-20-16600-2741-3070	R	258 IDA4	K	ONTS
259				
260				
261				
335-20-16600-2741	S-S-S-M	262 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
263				
335-20-16600-2741	S-S-S-M	264 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741	S-S-S-M	265 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741	S-S-S-M	266 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741	S-S-S-M	267 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
268				
335-20-16600-2741-3075-4029	R	269 IDA4	K	ONTS
335-20-16600-2741	S-S-S-M	270 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
271				
335-20-16600-2741-3070-4020	R	272 IDA4	K	ONTS
273				
335-20-16600-2741-3075-4021	R	274 IDA4	K	ONTS
275				
276				
277				
335-20-16600-2741	S-S-S-M	278 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR
335-20-16600-2741-3060	R	279 IDA4	K	ONTS
335-20-16600-2741	S-S-S-M	280 GEORGE RIVER IDA4	CH-CO-K-W	ONKE-ONKI-ONTS-PR

		281		
		282		
		283		
335-20-16600-2741		284 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		285		
		286		
		287		
		288		
		289		
		290		
		291		
		292		
		293		
335-20-16600-2741		294 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		295		
		296		
		297		
335-20-16600-2741		298 GEORGE RIVER	CH-CO-K-W	ONKE-ONKI-ONTS-PR
	S-S-S-M	IDA4		
		299		
		300		
		301		
		302		
		303		
		304		
		305		
		306		

Appendix Exhibit 4 - DESCRIBE COMO

FUNCTION - Defines the format of the MOSS multiple attribute file.

```
OK, MOSS AKHYDRO KEITH


OK, MOSS AKHYDRO KEITH


            MAP OVERLAY AND STATISTICAL SYSTEM
            *8908 32 BIT RELEASE* W/9001 PATCH

 PRIMOS version 22.0.1.DOI / F77 Rev. T1.3-21.0 REQUIRED
   "NEWS" COMMAND PROVIDES CURRENT SYSTEM INFORMATION

  IF YOU HAVE ANY PROBLEMS, CALL YOUR STATE GIS OFFICE
  IN EMERGENCIES,  CALL THE GIS HOTLINE:  (FTS) 776-0990
                                          (303) 236-0990


AKHYDRO is a valid MOSS MASTER PROJECT.

    ************************************
   *           FIELD VERSION            *
  *  32 BIT MOSS FOR PRIMOS  22.1.DOI    *
  *  Use only the 32 Bit 89.08 Manual    *
   *          *8908* 1/25/90            *
    ************************************
ENTER COMMAND ?  UTIL

 ENTER MOSS UTILITY OPTION
   1  =  TERMINATE UTILITY SESSION   [DEFAULT]
   2  =  DATABTEST    (MOSS MAP NAMES SUPPORT)
   3  =  ATTRIBUTE    (MOSS MULTIPLE ATTRIBUTE SUPPORT)
   4  =  ATTDES       (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
   5  =  SUB2AT       (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
   6  =  APROJ        (MOSS MAP NAMES PROJECTION ASSIGNMENT)
   7  =  BROWZ        (MOSS MAP NAMES HEADER LISTING)
   8  =  PLOT.LEGEND  (BUILD PLOTTER LEGEND FILE)
   9  =  MAKE.LOGO    (BUILD PLOTTER LOGO FILE)
  10  =  SUBEDIT      (MAP SUBJECT EDIT PROGRAM)
  11  =  SET.LEVEL    (BUILD POLYCELL TRANSLATION FILE)
  12  =  TRANSFORM    (TRANSFORM COORDINATES TO A PROJECTION)
  13  =  QUAD         (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
  14  =  DLG3         (USGS DLG ASCII TO MOSS)
  15  =  MAPIDX       (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
  16  =  XYSUBJECT    (REFORMAT POINT DATA TO MOSS)
  17  =  ATT2SUB      (ATTRIBUTE TO SUBJECT)
: 4
          *** ATTRIBUTE DESCRIPTION PROGRAM ***

What do you wish to call the Definition File
--------------------------------------
IDA4.DESC

 Provide a ten character description for "KEY"   1 [CR=Exit]
----------
STREAM-COD

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
ALASKA ADF+G STREAM CODES

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
```

```
OK, MOSS AKHYDRO KEITH


3

 What is the field length of this "KEY"?
47
 Attribute:          1     Key:        STREAM-COD
 Description:   ALASKA ADF+G STREAM CODES
 Type:       CHARACTER     Length:        47


 Edit options:   [0] - Proceed to next attribute (#   2)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   2 [CR=Exit]
----------
USER-ID

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
ARC-INFO USER ID

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select
3

 What is the field length of this "KEY"?
4
 Attribute:          2     Key:        USER-ID
 Description:   ARC-INFO USER ID
 Type:       CHARACTER     Length:         4


 Edit options:   [0] - Proceed to next attribute (#   3)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   3 [CR=Exit]
----------
STREAM-NAM

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
STREAM NAME

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
```

```
OK, MOSS AKHYDRO KEITH


3

 What is the field length of this "KEY"?
30
 Attribute.          3    Key:        STREAM-NAM
 Description:  STREAM NAME
 Type:       CHARACTER    Length:        30


 Edit options:   [0] - Proceed to next attribute (#   4)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   4 [CR=Exit]
----------
ADF+G SPEC

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
ALASKA DEPT. OF FISH AND GAME SPECIES ABBREVIATION

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
3

 What is the field length of this "KEY"?
30
 Attribute.          4    Key:        ADF+G-SPEC
 Description:  ALASKA DEPT. OF FISH AND GAME SPECIES ABBREVIATION
 Type:       CHARACTER    Length:        30


 Edit options:   [0] - Proceed to next attribute (#   5)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   5 [CR=Exit]
----------
BLM-SPECIE

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
BLM SPECIES ABBREVIATION

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
```

```
OK, MOSS AKHYDRO KEITH


3

 What is the field length of this "KEY"?
50
 Attribute:          5    Key:          BLM-SPECIE
 Description:  BLM SPECIES ABBREVIATION
 Type:      CHARACTER    Length:          50


 Edit options:   [0] - Proceed to next attribute (#   6)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   6 [CR=Exit]
----------
USE-SPECIE

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
SPECIES USAGE OF THE STREAM

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
3

 What is the field length of this "KEY"?
20
 Attribute:          6    Key:          USE-SPECIE
 Description:  SPECIES USAGE OF THE STREAM
 Type:      CHARACTER    Length:          20


 Edit options:   [0] - Proceed to next attribute (#   7)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
0

 Provide a ten character description for "KEY"   7 [CR=Exit]
----------
QUAD-NAME

 Provide a 60 character description of this "KEY"
------------------------------------------------------------
NAME OF THE MAP ON WHICH THE STREAM OCCURS

 The field type of this "KEY" is
  1 - Integer  2 - Floating point  3 - Character
Select:
```

```
OK, MOSS AKHYDRO KEITH


3

 What is the field length of this "KEY"?
4
 Attribute.          7     Key:        QUAD-NAME
 Description:  NAME OF MAP ON WHICH THE STREAM OCCURS
 Type:       CHARACTER     Length.         4


 Edit options:   [0] - Proceed to next attribute (#   8)
                  1  - Edit attribute KEY
                  2  - Edit attribute DESCRIPTION
                  3  - Edit field TYPE and LENGTH
                  4  - QUIT
                  5  - ABORT

 Select:
4
**** STOP


 ENTER MOSS UTILITY OPTION
   1   =   TERMINATE UTILITY SESSION    [DEFAULT]
   2   =   DATABTEST     (MOSS MAP NAMES SUPPORT)
   3   =   ATTRIBUTE     (MOSS MULTIPLE ATTRIBUTE SUPPORT)
   4   =   ATTDES        (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
   5   =   SUB2AT        (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
   6   =   APROJ         (MOSS MAP NAMES PROJECTION ASSIGNMENT)
   7   =   BROWZ         (MOSS MAP NAMES HEADER LISTING)
   8   =   PLOT.LEGEND   (BUILD PLOTTER LEGEND FILE)
   9   =   MAKE.LOGO     (BUILD PLOTTER LOGO FILE)
  10   =   SUBEDIT       (MAP SUBJECT EDIT PROGRAM)
  11   =   SET.LEVEL     (BUILD POLYCELL TRANSLATION FILE)
  12   =   TRANSFORM     (TRANSFORM COORDINATES TO A PROJECTION)
  13   =   QUAD          (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
  14   =   DLG3          (USGS DLG ASCII TO MOSS)
  15   =   MAPIDX        (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
  16   =   XYSUBJECT     (REFORMAT POINT DATA TO MOSS)
  17   =   ATT2SUB       (ATTRIBUTE TO SUBJECT)
  1


  MOSS UTILITY SESSION COMPLETED



BYE
  USER KEITH  EXITING MOSS
```

Appendix Exhibit 5 - .DESCRIBE FILE

FUNCTION - Lists results from the DESCRIBE program.

```
STREAM-COD
ALASKA ADF+G STREAM CODES
3
47
(T  1, A47)
1
USER-ID
ARC-INFO USER ID
3
 4
(T 48, A 4)
1
STREAM-NAM
STREAM NAME
3
30
(T 52, A30)
1
ADF+G-SPEC
ALASKA DEPT. OF FISH AND GAME SPECIES ABBREVIATION
3
30
(T 82, A30)
1
BLM-SPECIE
BLM SPECIES ABBREVIATION
3
50
(T112, A50)
1
USE-SPECIE
SPECIES USAGE OF THE STREAM
3
20
(T162, A20)
1
QUAD-NAME
NAME OF MAP ON WHICH THE STREAM OCCURS
3
 4
(T182, A 4)
2
```

Appendix Exhibit 6 - ADDATTRIBUTE COMO

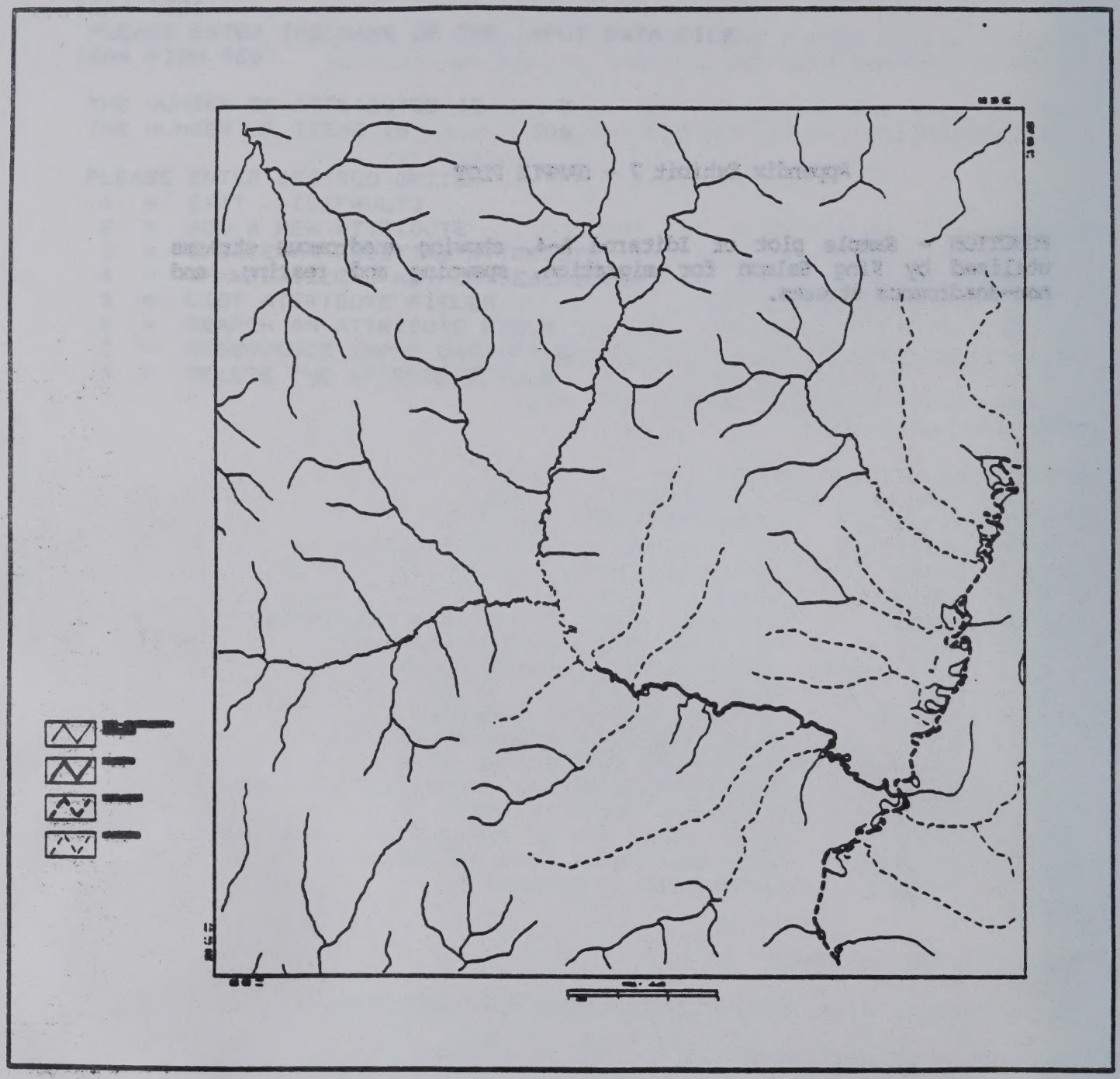
FUNCTION - Creates the relationship between the MOSS map and the MOSS multiple attribute file necessary to access the descriptive information associated with the MOSS map items.

```
MOSS AKHYDRO KEITH


MOSS AKHYDRO KEITH

            MAP OVERLAY AND STATISTICAL SYSTEM
            *8908 32 BIT RELEASE* W/9001 PATCH

 PRIMOS version 22.0.1.DOI / F77 Rev. T1.3-21.0 REQUIRED
   "NEWS" COMMAND PROVIDES CURRENT SYSTEM INFORMATION

  IF YOU HAVE ANY PROBLEMS, CALL YOUR STATE GIS OFFICE
  IN EMERGENCIES,  CALL THE GIS HOTLINE:  (FTS) 776-0990
                                          (303) 236-0990


AKHYDRO is a valid MOSS MASTER PROJECT.

    **********************************
   *          FIELD VERSION           *
  *  32 BIT MOSS FOR PRIMOS  22.1.DOI  *
  *  Use only the 32 Bit 89.08 Manual  *
   *          *8908* 1/25/90          *
    **********************************
ENTER COMMAND ? UTIL

 ENTER MOSS UTILITY OPTION
   1  =  TERMINATE UTILITY SESSION   [DEFAULT]
   2  =  DATABTEST   (MOSS MAP NAMES SUPPORT)
   3  =  ATTRIBUTE   (MOSS MULTIPLE ATTRIBUTE SUPPORT)
   4  =  ATTDES      (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
   5  =  SUB2AT      (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
   6  =  APROJ       (MOSS MAP NAMES PROJECTION ASSIGNMENT)
   7  =  BROWZ       (MOSS MAP NAMES HEADER LISTING)
   8  =  PLOT.LEGEND (BUILD PLOTTER LEGEND FILE)
   9  =  MAKE.LOGO   (BUILD PLOTTER LOGO FILE)
  10  =  SUBEDIT     (MAP SUBJECT EDIT PROGRAM)
  11  =  SET.LEVEL   (BUILD POLYCELL TRANSLATION FILE)
  12  =  TRANSFORM   (TRANSFORM COORDINATES TO A PROJECTION)
  13  =  QUAD        (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
  14  =  DLG3        (USGS DLG ASCII TO MOSS)
  15  =  MAPIDX      (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
  16  =  XYSUBJECT   (REFORMAT POINT DATA TO MOSS)
  17  =  ATT2SUB     (ATTRIBUTE TO SUBJECT)
: 3

 PLEASE ENTER MAP NAME
: IDA4
 THE ATTRIBUTE FILE DID NOT OPEN CORRECTLY.  CREATING IT.

 THE NUMBER OF ATTRIBUTES IS     0
 THE NUMBER OF ITEMS IS        306

 PLEASE ENTER DESIRED OPTION
   1  =  EXIT   [DEFAULT]
   2  =  ADD A NEW ATTRIBUTE
   3  =  UPDATE AN EXISTING ATTRIBUTE
   4  =  CHANGE/DELETE KEY OR DESCRIPTOR
   5  =  LIST ATTRIBUTE FIELDS
   6  =  SEARCH AN ATTRIBUTE FIELD
   7  =  RESEQUENCE INPUT DATA FILE
   8  =  DELETE THE ATTRIBUTE FILE
```

```
MOSS AKHYDRO KEITH


  2
WILL YOU BE USING A DEFINITION FILE? [CR = NO]
  Y
 ENTER THE NAME OF THE ATTRIBUTE DEFINTION FILE
IDA4.DESC
 PLEASE ENTER THE NAME OF THE INPUT DATA FILE
IDA4.FISH.RES

 THE NUMBER OF ATTRIBUTES IS      7
 THE NUMBER OF ITEMS IS         306

 PLEASE ENTER DESIRED OPTION
  1  =  EXIT   [DEFAULT]
  2  =  ADD A NEW ATTRIBUTE
  3  =  UPDATE AN EXISTING ATTRIBUTE
  4  =  CHANGE/DELETE KEY OR DESCRIPTOR
  5  =  LIST ATTRIBUTE FIELDS
  6  =  SEARCH AN ATTRIBUTE FIELD
  7  =  RESEQUENCE INPUT DATA FILE
  8  =  DELETE THE ATTRIBUTE FILE
```

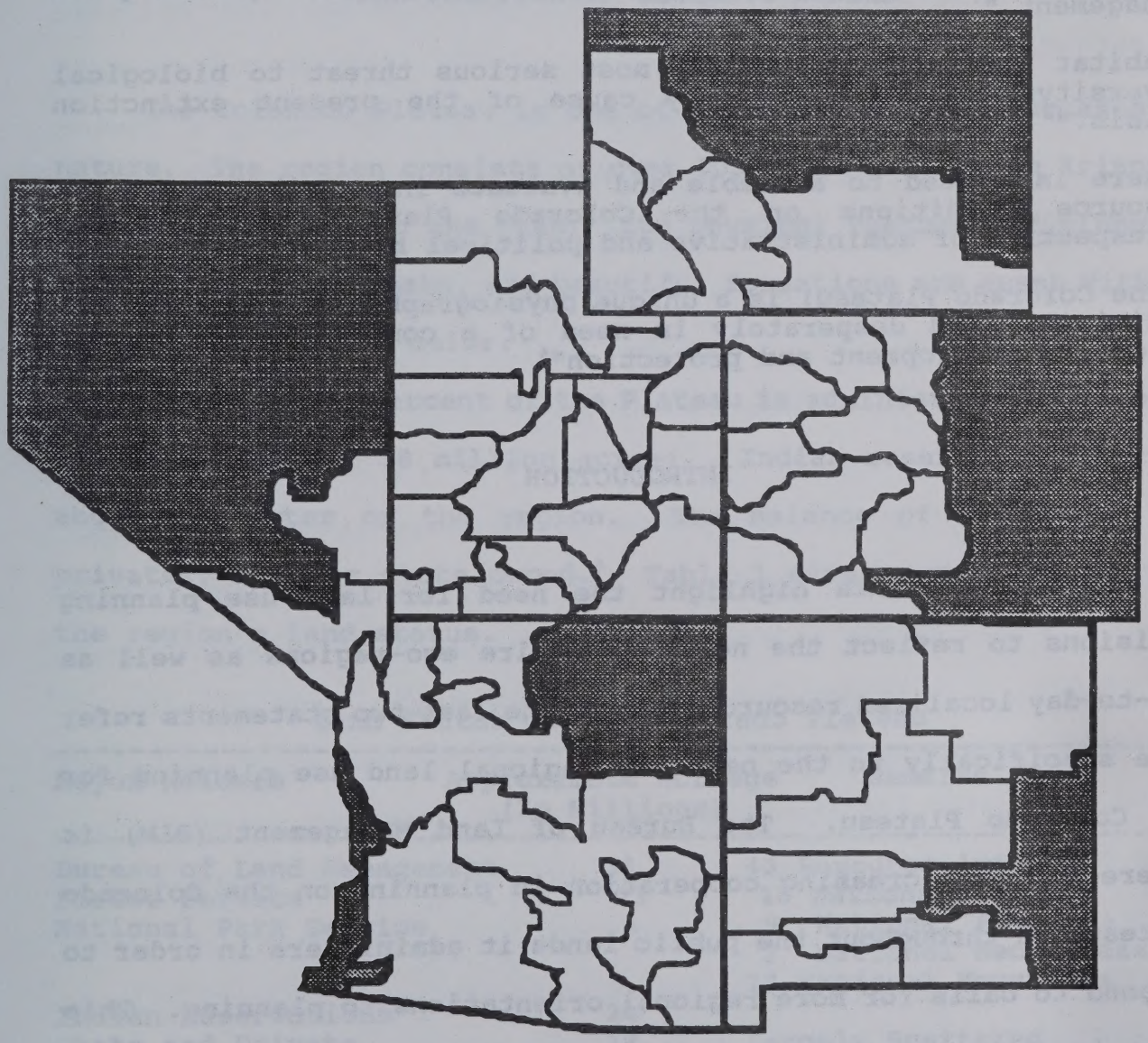
Appendix Exhibit 7 - SAMPLE PLOT

FUNCTION - Sample plot of Iditarod A-4, showing anadromous streams utilized by King Salmon for migration, spawning and rearing, and non-anadromous streams.



SPECIES USAGE FOR KING SALMON – IDITAROD A4, ALASKA

Land Use Planning For the Colorado Plateau: Opportunities and Obstacles



U.S. Bureau of Land Management
Office of Planning and
Environmental Coordination
Washington Office (WO760)

Chuck Hunt
(202) 653-8824
FTS 653-8824
November 20, 1990

LAND USE PLANNING FOR THE COLORADO PLATEAU:

OPPORTUNITIES AND OBSTACLES

"Entire regional ecosystems are the areas where multiple use and multiple value are planned and scheduled to conserve high quality biological areas as well as meet people's needs for resources...For the BLM this means stronger plans and more cooperative planning and management."[1]

"Habitat fragmentation is the most serious threat to biological diversity and is the primary cause of the present extinction crisis."[2]

"There is a need to assemble and evaluate information about the resource conditions on the Colorado Plateau as a whole, irrespective of administrative and political boundaries."[3]

"(The Colorado Plateau) is a unique physiographic province that is indivisible and desperately in need of a comprehensive plan to guide its development and protection"[4]

INTRODUCTION

The above statements highlight the need for land use planning decisions to reflect the needs of entire eco-regions as well as day-to-day localized resource needs. The last two statements refer more specifically to the need for regional land use planning for the Colorado Plateau. The Bureau of Land Management (BLM) is interested in increasing cooperation in planning on the Colorado Plateau and throughout the public lands it administers in order to respond to calls for more regional orientations to planning. This paper is going to present a discussion of the increased interest in a more consistent approach to land use planning on the Colorado

Plateau, both in terms of consistent planning and data collection, and some of the obstacles facing just one of the federal land management agencies present in the region, the BLM. The discussion concerning obstacles will deal with the process, policy and technical dimensions of the issue.

THE FRONTIER OF GEOLOGIC WONDER

The Colorado Plateau is one of America's finest showcases of nature. The region consists of over 100,000,000 acres in Arizona, Colorado, New Mexico and Utah. Its physical features of plunging canyons, towering peaks, and beautiful formations are awash with an incredible range of color.

About sixty-percent of the Plateau is administered by federal agencies (roughly 58 million acres). Indian reservations occupy about a quarter of the region. The balance of the region is privately held or state owned.[5] Table 1 gives greater detail of the region's land status.

Table 1
Land Status on the Colorado Plateau

Major Holders	Approximate Acreage (In Millions)	Remarks
Bureau of Land Management	31	43 Resource Areas
Forest Service	23	18 National Forests
National Park Service	4	9 National Parks 2 National Rec. Areas 12 National Monuments
Indian Reservations	24	
State and Private	18	Largely Scattered
Total	100	

The Colorado Plateau is becoming quite the center of attention. The Grand Canyon Trust is in the process of developing the Colorado Plateau Resource Monitoring Program. The Center For the New West is working to develop through the Colorado Plateau Tourism Development Commission a comprehensive plan to guide tourism development on the Colorado Plateau. The Wilderness Society has initiated a project to analyze the environmental and economic interrelationships in the region. Lastly, the Bureau of Land Management is exploring the possibility of developing a common format to portray Colorado Plateau planning data in an effort to collect data for the Department of the Interior's Global Change efforts.

The Grand Canyon Trust Efforts

The Grand Canyon Trust is in the process of developing the Colorado Plateau Monitoring Program. The program will offer decision makers synoptic ecological and economic information about the natural and cultural resources within the region, publish documents showing comparative data on resource conditions and trends, encourage the focusing of management attention on publicly-owned resources that are degraded or impaired, promote creative and cooperative strategies and programs for improving resource management and monitor effects of new programs once they are implemented.

The program will feature a computer-based resource inventory

and assessment system. It will seek to use data from a wide variety of sources including state and federal agencies, private organizations and other research institutions. Geographic Information Systems (GIS) technology will be utilized to analyze much of the gathered data.[6]

The Center For the New West Initiative

The Center for the New West is an independent, non-profit policy research and consulting institution based in Denver. One of its main goals is to promote the orderly development of tourism on the Colorado Plateau. It recognizes that tourist resources often "spill across state lines" which necessitates that new institutional arrangements and forms of management be established.

The Center hopes that the efforts of the Colorado Plateau Tourism Development Commission can over come state borders to develop tourism resources in a "systematic, comprehensive and rational manner." To do this, the Commission is developing a plan for the region. This plan will be supported by data from a variety of sources including federal land use planning activities.[7]

The Wilderness Society

The Wilderness Society will be applying GIS technology to create an analytical framework that links diverse data as demography, climate, topography, economy, wildlife ranges, land use

patterns and other characteristics of specific sites. A prominent source of data will be federal land use plans. The Society contends that the dependency on extractive industries has provided the region with an unstable economy. It seeks to use its analysis capabilities to influence the rebuilding and diversification of the region's economy to protect and restore the outstanding environmental values of the region.[8]

The BLM's Global Change Efforts

The BLM believes that it has much to offer in the global change arena in terms of monitoring, adaption and mitigation. Proposals are being made that would seek to provide consistency to the BLM's planning activities on the Plateau to allow the products of its planning process and data to monitor the effects of global change.

Considerable public benefits could be realized if all federal land management agencies were able to portray a unified base of land use plans and comparable data for the region in order to support the activities such as those of the Grand Canyon Trust, etc. and to permit a more comprehensive, coordinated planning environment that avoids the creation of plans in a void which are primarily influenced by artificial administrative borders, etc. The BLM is interested in working with other land management agencies in order to pursue more comprehensive, coordinated planning.

It is evident that the Colorado Plateau is the center of much attention. Once again, the ideal world would feature the federal land management agencies, state and local governments and Indian tribes conducting land use planning in a consistent fashion, one that would yield data that could be used for regional analysis. However, strictly implementing a consistent approach within just one of the agencies is problematic, much less across the board.

The BLM has been a leader in the region in using GIS for land use planning. The use of GIS has created some impetus for greater consistency in land use planning. The BLM is making progress in this area, but still has some way to go. The balance of the paper is going to deal with the BLM land use planning process and discuss some of the difficulties the Bureau would face in portraying a unified land use plan (data and decisions) for the Colorado Plateau.

THE BLM'S PLANNING PROCESS

The BLM has worked with a number of approaches to land use planning in its forty-five year history. Starting in 1977, it began developing Resource Management Plans (RMP). Environmental Impact Statements (EIS) are prepared in conjunction with RMP's to determine how the BLM will manage the public land resource values in each of the BLM's administrative units known as Resource Areas. A little over half of the first generation of RMP's have been

completed. Table 2 presents the basic procedural steps of the RMP process.

Table 2
Basic Steps of BLM's Resource Management Plans

1. Develop public Participation
2. Identify Issues
3. Develop Planning Criteria
4. Gather Information, inventory resources
5. Analyze management situation
6. Formulate management alternatives
7. Estimate effects of alternatives
8. Select preferred alternative
9. Publish draft RMP/EIS
10. Publish proposed RMP/ Final EIS
11. Monitor and evaluate overall plan
12. Prepare activity plans where necessary

[Activity plans are detailed plans for the management of a single resource program. The steps are not necessarily sequential, information gathering (data base development) can begin many years before the formal planning begins.]

The actual plan preparation usually takes 24 to 30 months; however, the entire process from preplanning and scoping activities through final approvals usually involves about four years.

The Use Of GIS In The Preparation Of RMP's

GIS has been used in the preparation of about a 30 of the BLM's RMP's. The BLM has been very pleased with the application of GIS to its planning efforts. RMP's prepared with GIS support have featured numerous maps of alternatives that greatly aid in the selection of the proposed alternative. Furthermore, the analysis capabilities have greatly facilitated the treatment of many

variables, the computation of impacted acreage, etc.

Recently, The Washington Office of Planning and Environmental Coordination issued the Guide to the Identification of GIS Data Themes for Use in the Resource Management Plan Process. This guide supplies much of the information that planning teams need before embarking on a GIS-supported RMP effort.

The guide points out the necessity of beginning data base development well before RMP preparation is actually initiated. Aside from specifying the usual desired scales, data collection methods, etc., it presents lists of possible data themes needed to support the planning process. This guide will make using GIS more efficient and assist in obtaining more consistency to GIS-supported RMP's.

PROBLEMS ASSOCIATED WITH A UNIFIED PORTRAYAL OF BLM'S PLANNING DECISIONS (DATA) FOR THE REGION

This paper has dealt with the attractiveness of a unified, coordinated portrayal of BLM's land use planning decisions for the Colorado Plateau. The best scenario would not only feature a unified portrayal of the planning decisions, but also a consistent data base that could be pulled together across administrative lines (resource area boundaries) to permit regional analysis.

The above scenario, while very desirable, has some substantive obstacles. The obstacles can be characterized as process, policy and technological. It is quite possible that the latter one,

technological, is the one most easily overcome.

Process Obstacles

The process obstacles include the timing of RMP activity, the National Environmental Policy Act (NEPA) process and the decentralized approach to planning.

Timing

In order to maximize the BLM's limited resources and permit prioritization, the BLM has established an RMP completion schedule that emphasizes national or Resource Area programmatic priorities not regional analysis capabilities. A regional approach has been taken only in Western Oregon and the California Desert District.

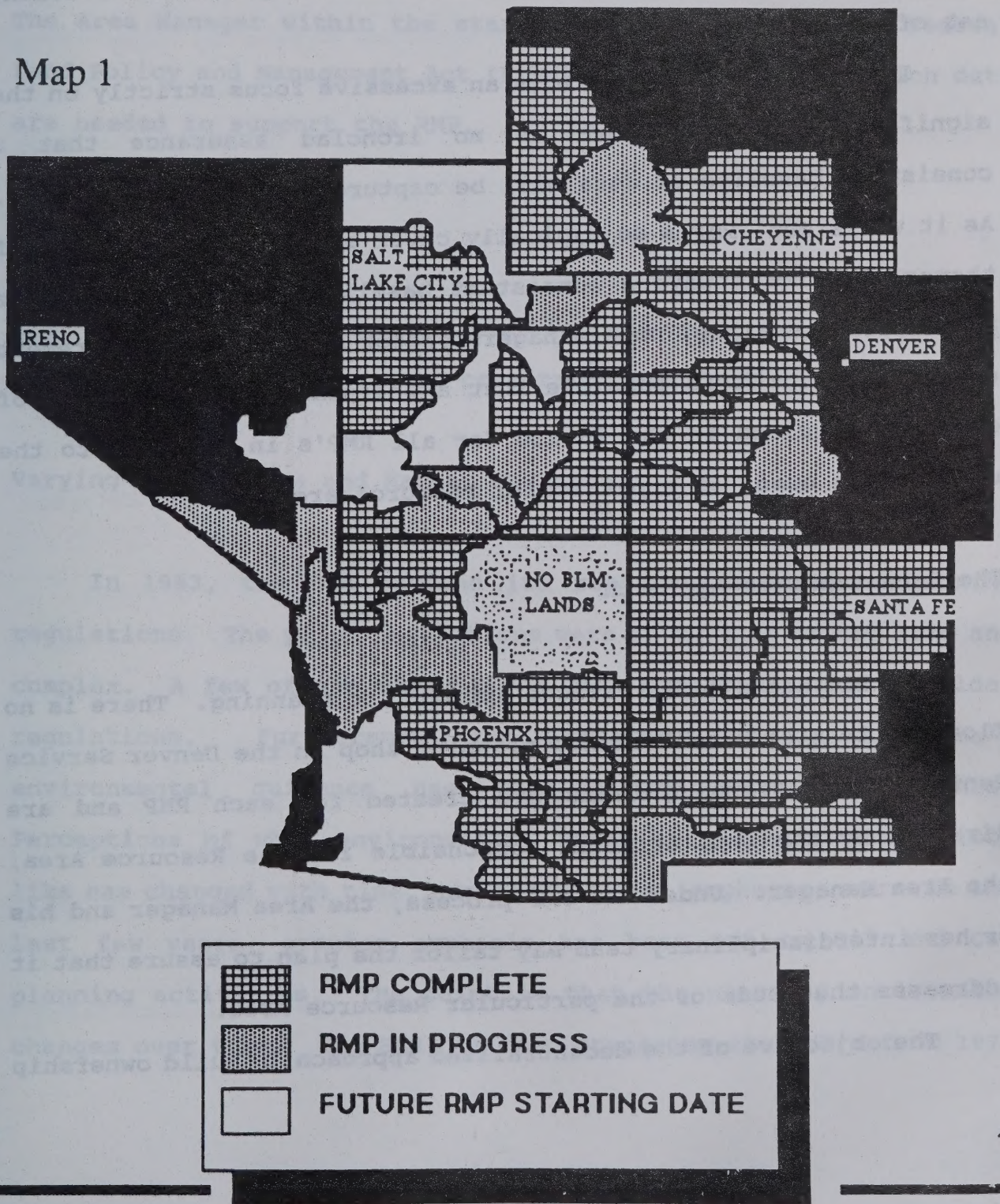
This means that for the BLM 43 Resource Areas present on the Plateau, there is a wide variety of RMP completion dates. Some have not been started, others have been completed for some time. Map 1 portrays the status of RMP activities on the Plateau.

The Bureau has strived to ensure that consistent data have been collected for these RMP efforts. However, the variability of the timing of the efforts, does make consistency a challenge. As the BLM has gained more experience in the RMP process, consistency has improved.

The NEPA Process

Land Use Planning For the Colorado Plateau: Opportunities and Obstacles

Map 1



The NEPA process requires a "fluid" identification of the issues.[9] All interested parties must have the opportunity to participate in the scoping process and to identify issues. This is positive from the standpoint of ensuring all significant issues are covered, but it means that each RMP may develop with a different set of issue emphases.

In other words, if there is an excessive focus strictly on the significant issues, there is no ironclad assurance that a consistent baseline of data will be captured to support each RMP. As it works out, RMP's do typically cover a consistent baseline of themes, but not always a consistent baseline of data about these themes. For example, some managers prefer one type of measurement over another. It is possible that a uniform baseline of data of could be required in the future for all RMP's in addition to the unique data needs of a particular resource area.

The Decentralized Approach

The BLM has a decentralized approach to planning. There is no floating team or a centralized planning shop in the Denver Service Center. The planning teams are created for each RMP and are directed by the line official responsible for the Resource Area, the Area Manager. Under the RMP process, the Area Manager and his or her interdisciplinary team may tailor the plan to assure that it addresses the needs of the particular Resource Area.

The objective of the decentralized approach is build ownership

of the plan by the individuals who will have to carry it out.[10] The BLM found from past experiences that plans developed in a centralized setting are often neglected "on-the-ground." This approach, however, does tend to reduce the consistency of the RMP's, particularly in the areas of standardized data collection. The Area Manager within the standards established by the Federal Land Policy and Management Act (FLPMA) and NEPA decides which data are needed to support the RMP.

The Policy Obstacles

The numerous policy obstacles include the varying regulations and the issues of management commitment and funding limitations.

Varying Regulations and Manual Guidance

In 1983, the BLM revised its resource management planning regulations. The prior regulations were thought to be too long and complex. A few of the early RMP's were prepared using the older regulations. Furthermore, the Department of the Interior's environmental guidance has changed some over the years. Perceptions of what environmental impact statements should look like has changed with time, administrations, emphases, etc. In the last few years, greater emphasis has been put on Oil and Gas planning activities. The point is that the planning environment changes over time. The BLM has been preparing its RMP's from 1979

until the present. It is likely that their consistency has been affected by the changes discussed above.

Management Commitment

Managers of land management agencies typically have their hands full with just the issues of their administrative unit. There is usually limited resources and time to pursue broader issues such as interagency cooperation. This reality does not facilitate cooperation and consistency across administrative boundaries with other administrative units much less outside parties. This is not to say that land management agencies do not cooperate a good deal both internally and externally. Cooperation is rather common in many of the BLM's activities. The area of automation will most likely lead to much more cooperation in areas such as data collection and sharing.

Funding Limitations

Funding limitations may enforce inconsistent RMP efforts. When funding limitations are too severe, managers will be forced to concentrate mainly on their top priorities. In the case of the BLM, Resource Area managers may collect data in their high priority programs irrespective of the whole BLM's needs. The requirement to develop a baseline data base to facilitate a "regional data base" in addition to the priority data base development, may not be

feasible given budgetary realities.

Technological Obstacles

Technological obstacles are often seen as the most insurmountable. It is very likely that this is not the case. In reality , they become less insurmountable with each and every day. Hardware, software and expertise is becoming more common throughout the Plateau region both inside and outside the BLM. Nevertheless, technological obstacles still exist. They include the scarcity of GIS capability and data, the presence of older RMP's that featured little automated support and the lack of standards ranging from format standards to collection standards.

Scarcity of GIS Support Hardware and Data

Limited GIS capability is available in most of the 43 Resource Areas on the Colorado Plateau. However, advanced GIS experience and supporting hardware is still primarily confined to the State Offices with some notable exceptions. Most of the GIS-supported RMP's prepared in Resource Areas receive significant assistance from the State Offices. As a result, many specialists in the BLM's programs out in the Resource Areas haven't fully started thinking about planning in terms of building a data base to support GIS analysis. However, the trend is definitely in that direction.

Once most program specialists start to think in these terms,

there could be greater emphasis for more structured data base development. The previously mentioned Guide to the Identification of GIS Data Themes for Use in the Resource Management Plan Process should help in this area. GIS capability, both in terms of know how and hardware support, will remain a serious obstacle to the ability to present consistent data across administrative boundaries and thus present a unified portrayal of land use plans.

Presence of Older RMP's

Many of the early RMP's featured little automated support. It is not that they aren't filled with very useful data, it is just the fact that it is more difficult to use, at least in an automated sense. Older data base technology coupled with scarcity of automated data period, severely limit the contribution that these RMP's can make to a regional data base.

Lack Of Standards

This one is the critical technological obstacle. Without standards the acquisition of more expertise, hardware support and even much improved software means little in terms of providing a regional analysis capability. Standards is a very broad term. Standards can pertain to wide variety of actions. There are software standards, format standards, data dictionary-type standards, data collection standards and so on. It is not enough

to just collect data under some of the same data themes, they must be collected the same way or at least be documented to show how they were collected in both a digitizing sense and an "on-the-ground" sense.

Software And Format Standards

Software standards pertain to having all GIS users using the same software package. This has not been a major concern in the BLM. The BLM has had ADS-MOSS as its standard for many years. This is not the case in many organizations. For instances, the Forest Service uses both MOSS and Arc/Info. In such an environment, the issue of format standards comes into play. In other words, can the data format of a MOSS file be translated for use in Arc/Info?

There are many formats that have gained wide acceptance. For example, the National Mapping Division's Digital Line Graph-3 is a format that most GIS's can use. Software developers have been largely successful in translating from one format to another format; however, some formats just cannot be translated. Furthermore, some formats can be translated, but require significant editing. In fact, some translations require so much editing that it is more cost effective to just "recapture" the data in the desired format. Though the issue of format standards is being largely overcome through translation capabilities, it still offers a challenge to the would be developers of a regional data

base.

Data Dictionary (And Collection Standards)

Another possible technological obstacle is the lack of data dictionary-type standards that refer largely the metadata requirements that need to accompany the data element occurrences. For data to be used side-by-side other data, the user needs to know a lot about the data. He or she needs to know things such as how the data was collected, when was it collected, who collected it, how accurate is the data, and most importantly--how is the data defined?

Without these data (metadata) it is impossible for the user to know if the data are comparable. For instance, if one data collection methodology involved classification of vegetation by remote sensing and another used more traditional sampling means, it may not be advisable to use the two as though no differences existed between the two data sets. Furthermore, if pinion-juniper stands were defined differently by the BLM and the Forest Service, it once again may be inadvisable to use the two without qualification. Once again, the user would need to be able to check the definition of the data element in both the BLM and Forest Service's data dictionary.

In reality, two question of standards exist here. One is a standard of maintaining data dictionaries. Another is using the same data element definitions and at times same collection

methodologies. Without consideration of the question of standards, efforts at bringing together land use planning data to facilitate regional analysis are at best on shaky ground.

CONCLUSION

The Colorado Plateau is an incredible resource to the nation. Consistent land use planning, and data collection where appropriate, by the land managers in the region would go a long way toward ensuring wise use of this resource. Efforts of many groups such as the Grand Canyon Trust, the Center for the New West, the Wilderness Society and the desire of the BLM to contribute to the global change efforts, highlight the need for such action.

The BLM has been making good progress in addressing many of these obstacles. The future for more consistent planning and data base development appears bright. However, it is evident from the example of the BLM that each agency has many obstacles to overcome. The purpose of this paper has not been to declare that consistent land use planning and data collection are impossible. Rather, it has sought to more clearly define the obstacles to facilitate overcoming them in the future.

1. Dick Dworsky, "A Global Warming Response Program - Opportunities For The BLM," Draft Discussion Paper, BLM Alaska State Office, 1990, p. 7.

2.Larry D. Harris and Peter B. Gallagher, "New Initiatives for Wildlife Conservation: The Need for Movement Corridors," in Preserving Communities and Corridors, ed. Gay MacKintosh (Washington, D.C.: Defenders of Wildlife, 1989), p. 25.

3.Roger Clark, "The Colorado Plateau Resource Monitoring Program," The Grand Canyon Trust 1990, p. 1.

4.Kent Briggs, Senior Fellow, Center for the New West, Letter to the New mexico State DIrector, May 7, 1990, p. 3.

5.The Colorado Plateau boundaries are defined differently by different organizations. The figures used in this paper reflect the Grand Canyon Trust's description of the Plateau.

6.Clark, pp. 1-2.

7.Briggs, pp. 1-4.

8.Tom Goerold, "Environmental and Economic Sustainability in the Four Corners Ecoregion (Draft)," The Wilderness Society 1990, pp. 1-6.

9.40 CFR 1501.7

10.David C. Williams, "Planning Approaches in the Bureau of Land Management," Trends, Vol. 24, Number 2 (1987), p. 32.

FRAGMENTATION MODEL
MOUNT HOOD NATIONAL FOREST
DECEMBER 1989

FRAGMENTATION TASK FORCE

Tom Hussey, Chair
Barbara Kott
Dave Zalunardo
Ranotta McNair

Special Thanks to:

Curtis Day
Chris Topik, Ph.D.

FRAGMENTATION MODEL
MT. HOOD NATIONAL FOREST
DECEMBER 1989

The Mt. Hood National Forest is committed to maintaining the significant old-growth ecosystems in the Pacific Northwest in accordance with Section 318 of the 1990 Appropriations Act. This legislation acknowledges the ecological significance of old-growth forests and directs the U.S. Forest Service and Bureau of Land Management to minimize the fragmentation of old-growth in planning the 1990 timber sales program.

Fragmentation is the process of breaking up contiguous stands of old-growth forests into smaller and smaller patches, such that the interior habitat of the residual patches is eliminated and the distance between remaining old-growth stands increases. Species of plants and animals that depend on these habitats become isolated in the islands of old-growth. The resulting inbreeding of the population can reduce its ability to survive.

The issue becomes how to retain stands of old-growth, while harvesting timber. A task force of technical specialists was appointed to consider issues of fragmentation. The committee was composed of specialists in the field of silviculture, timber management, wildlife, ecology, and geographic information systems. This committee compiled current research on old-growth ecosystems and fragmentation, to develop a model that will assess the fragmentation effect of 1990 timber sale program and to assist the advisory board in use of this model in making management decisions.

THE MODEL

The forest attributes analyzed came from the Mt. Hood two-step vegetation inventory. The *VEG88* inventory, conducted in 1984 and updated in 1988, used aerial photo delineation of stands and quantitative field sampling of vegetation in a stratified, random design. The mature and overmature (*MOMS*) inventory conducted in 1989, provided more detailed information regarding tree size and stand structure for the same stands delineated in the *VEG88* inventory.

The sub-basin drainage was chosen as the analysis area, as many plants, animals, soil types and hydrologic systems are fairly well defined by these 50,000 to 100,000 acre basins.

Analysis of current and potential fragmentation was done at two resolutions. First, the 15 drainages within the Forest were ranked by the degree of fragmentation that has occurred in each. Then, stands within the drainages meeting the definition of old-growth were ordered from least to most fragmented. Proposed timber harvest units were then overlaid on current stands to analyze the effects of these harvests on fragmentation.

Analysis was done using a fragmentation model developed by the Mt. Hood National Forest. This model compares stand age; stand size; the shape of the stand with consideration for the influence of various edge types; and the proximity or spatial arrangement of neighboring stands. Geographic Information System (GIS) was used extensively in the analysis procedure.

METHOD

The forest databases were queried for stands meeting the definition of ecologically significant old-growth as outlined in Section 318. They were given 120 meter *buffers* from their edges in, and along all roads that penetrated them. Where old-growth stands abut second growth stands or plantations they lack some attributes which are characteristic of old-growth interior forest. Current studies define "edge" as 120 meters from the perimeter.

Stands of trees at least 80 feet in height but not meeting the definition of ecologically significant old-growth, were mapped as *other forest*. Additionally, natural openings and stands less than 80 feet in height were mapped as *openings*. This established the surrounding forest condition for use in the model.

Fragmentation was determined within the drainages by calculating the total acres of *other forest* and *openings*; the total acres of forest lying in the 120 meter *buffers*; the total acres of remaining ecologically significant old-growth *core*; and the total acres of old-growth with *no core* area.

Here, the stand size characteristic of the model comes into play. *Core* acres were given a weight of 1.0, *buffers* received .5, stands containing *no core* acres received .01 and a value of 0 was assigned to the remaining acres.

The value of each drainage was determined by multiplying the proportion of the analysis area that each of these conditions occupied by the weight it had been given. The results were added and this sum multiplied by 100. It was then possible to rank the drainages numerically, 0 to 100 with the higher score indicating less fragmentation.

FRAGMENTATION

To analyze the impact of the 1990 timber sale program, a "neighborhood" or "proximity" analysis was completed using GIS. Here the shape and spatial characteristics of the landscape were incorporated into the model. Five values were assigned to forest conditions. Values were based upon a scale of 0 to 20 reflecting the effect upon the old growth stands.

The following are values assigned forest conditions:

Unfragmented *core* areas	20
Unfragmented core areas bounded by *other forest*	15
Core areas fragmented by roads	4
Unfragmented core areas bounded by *openings*	3
Non-forest areas	0

A map of the Forest was divided by a grid, each cell measuring two acres. Each cell received a value based upon stand condition. The SCAN function of GIS was then used to produce a proximity map. This function reassigns a cell's value based on the value of the 24 closest cells (1/8 mile radius). This had the effect of weighting stands spatially, instead of by their stand condition.

A map of proposed harvest units was then overlaid on the proximity map. Cell values falling within the harvest units were summed, allowing harvest units to be ordered by their degree of effect.

OUTPUT PRODUCTS

The fragmentation model produces tables and maps. Both types of information can be viewed in either a forest overview scale or in a drainage or analysis area scale.

Table data - Information can be obtained which shows the forest-wide picture of how much old-growth we have, how it is distributed across the Forest, and how the proposed timber harvest activity would affect the total old-growth on the Forest. Information can be obtained for the individual stands within an analysis area showing total size, core area, changes due to timber harvest and the individual affect of each harvest unit.

Map Data - Information can be obtained in map form illustrating Forestwide views of ecologically significant old-growth. Because of the GIS technology being used, the map base or map scale can be changed to meet the requirements of the user. Maps can also be generated to show drainage stand characteristics, i.e. *old-growth, other forest* and *openings.*

USES OF THE FRAGMENTATION MODEL

Cumulative effects analysis -The fragmentation model maps and tables will provide useful tools for analysis of the cumulative effect of individual timber sales. The ability of the GIS to plot old-growth on any chosen scale allows the analysis to be custom tailored to the scale of the issue being analyzed. The mapped data will provide a visual picture of the old-growth stands and their spatial arrangements. The tabular data will allow both a look at the acres of *ecologically significant old-growth* impacted and at the fragmentation effects on the old-growth stands.

Timber program planning - Another forest level use of the fragmentation model is in out-year timber sale planning. Forest-level maps and tables are tools we can use for deciding which drainages to select for project level planning and which ones to by-pass. Program efficiency should be enhanced because we will be able to target our investment in detailed project planning in drainages where fragmentation of old-growth stands is less of a constraint.

External information requests - The flexibility of GIS and the fragmentation model allow us to respond effectively to external publics, so the use of this tool is essential to responding to information requests. By changing the parameters of the GIS query, or of the values imbedded within the model, we should be able to heed most of the information requests having to do with Mt. Hood National Forest old-growth. We can tailor our response to the definitions being used by the customer, to their geographic area of interest and to the scale of their issue and display the data in both table and map format.

Project level analysis - The fragmentation model will be useful to district interdisciplinary teams in project design. They will be able to determine and display the size and location of old-growth stands and have a ranked list based on current fragmentation values. They will be able to test alternative timber sale designs by changing the location or size or shape of harvest units and seeing how those changes affect the old-growth fragmentation index. Alternatively, the team could use the table data to review each of their proposed harvest units for remedial action. Project level cumulative effects analysis for old-growth will be greatly enhanced by the availability of this tool.

Model flexibility - There is a high degree of flexibility built into this model and its greatest utility will be apparent when the flexibility is fully understood by the user. The user can custom fit the model to the local need, fine tune it as knowledge of old-growth resources improves, or simply conduct sensitivity analysis of effects of different assumptions. Some of the key flexible features include:

Definition of old-growth: The initial uses of the fragmentation model use two definitions: 1) Stands meeting the definitions in PNW 447 and, 2) stands occupied by Northern Spotted Owls. Other definitions could be used by simply changing the query used to lift the qualifying stands from the vegetative database. The only limitation to flexibility in the definition of old-growth is the requirement that the vegetative characteristic used must be one of those in the vegetative database or one that could be inferred from a characteristic database.

Weighting of values for stand geometry: Stand shape could assume more or less importance if desired by the user simply by changing the value assigned to the size/parameter relationship in the model. This would allow the user a way to either decrease or increase the importance assigned to core habitat.

Weighting of values for edge effect: The weighting values assigned to stand edge habitats can be changed, based on the characteristics of adjacent stands or on changes in the assumptions of the user or on further research.

DISCLAIMER

The fragmentation model produces tables and maps what will be very useful in resource analysis and decision making. It is a flexible tool that can be modified to fit the needs of the user. But its effective use requires that it be treated with a lot of disrespect. A few words must be said about its limitations.

The fragmentation model does not define "ecologically significant old-growth." The user does. The model merely displays the stands meeting the characteristics defined by the user.

There are limitations to the basic vegetative data. Much of the Mt. Hood vegetative resource inventory is based on aerial photo interpretation. There are weaknesses in this database, particularly for those stand characteristics not easily photo-identifiable. This is most noticeable when trying to define old-growth based on understory vegetation, snags, and downed woody debris. The user can get around some of these basic data weaknesses by using reliable stand characteristics to infer weak data elements, but there is an obvious compromise involved here.

The model does not resolve any issues. It does display data and allow people to conduct sensitivity analysis on that data. It does not suggest what timber harvest strategy to follow or what old-growth conservation strategy is best. It is no substitute for intelligent resource analysis and policy makers.

The model flexibility carries with it some dangers. If the weighting factors within the model are given illogical values, either through misunderstanding of the ecological factors those values are intended to represent, or through deliberate attempts to deceive, illogical outputs will be produced.

None of these cautions are intended to denigrate the utility of the fragmentation model. As with all models, it is a simplification of the real world, not a reflection of it. Its power comes from that simplification. It can display complex sets of data, integrate inter-related factors, and perform sensitivity analysis on differing

assumptions. If the user is fully aware of the limitations of this model, he or she will find it a very useful tool for analyzing fragmentation of ecologically significant old-growth on the Mt. Hood Forest.

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Irwin, L. In Review, Incentives for Managing Biodiversity, In the proceedings of the Symposium on Wildlife Diversity and Landscape Patterns in Northwest Coastal Forests. Newport, Oregon, September 1989.

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Appendix 1 - 447 Old Growth

Flowchart for determining stands that meet the PNW 447 definition of old growth.

1.Is stand classified as a western-hemlock site or a Pacific-silver-fir site that is below 3600' with Douglas fir present?
Yes? 2. No? Removed from consideration.

2.Is the total stand crown closure greater than 20%?
Yes? 3. No? Removed from consideration.

3.Are there dominant and co-dominant trees greater than or equal to 32" DBH?
Yes? 4. No? 9.

4.Is the total stand crown closure greater than 50%?
Yes? **Meets PNW 447 definition.** No? 5 (or 15 if in loop from step 10)

5.Is this a multi-storied stand?
Yes? 6. No? Removed from consideration.

6.Are there shade tolerant species present in the understory (i.e. western hemlock, Pacific silver fir, western red cedar, grand fir, or big leaf maple)?
Yes? 7. No? Removed from consideration.

7.Are the mid-level canopy trees greater than or equal to 8" DBH?
Yes? 8. No? Removed from consideration.

8.Is the crown closure for the mid-level trees greater than 10%?
Yes? **Meets PNW 447 definition.** No? Removed from consideration.

9.Are there dominant and co-dominant trees greater than or equal to 21" DBH?
Yes? 10. No? Removed from consideration.

10.Is the maximum crown diameter present greater than or equal to 23 feet?
Yes? Back to 4. No? Removed from consideration.

Appendix 2 - R6 Old Growth

Flowchart for determining stands that meet the Regional Guide definition of old growth.

1.Is the stand classified as a Pacific-silver-fir site above 3600' elevation?
Yes? 2. No? 10.

2.Is the total stand crown closure greater than 20%?
Yes? 3. No? Removed from consideration

3.Are there trees greater than or equal to 32" DBH present?
Yes? 4. No? 8.

4.Is the total stand crown closure greater than 50%?
Yes? **Meets R6 Guide definition.** No? 5

5.Is this a multi-storied stand?
Yes? 6. No? Removed from consideration.

7.Are the mid-level canopy trees greater than or equal to 8" DBH?
Yes? **Meets R6 Guide definition.** No? Removed from consideration.

8.Are there trees greater than or equal to 21" DBH present?
Yes? 9. No? Removed from consideration.

9.Is the maximum crown diameter present greater than or equal to 23 feet?
Yes? Back to 4. No? Removed from consideration.

10.Is the stand classified as a mountain hemlock or mixed conifer site?
Yes? 11. No? Removed from consideration.

11.Is the total stand crown closure greater than 20%?
Yes? 12. No? Removed from consideration

12.Are there trees greater than or equal to 21" DBH present?
Yes? 13. No? Back to 9.

13.Is the total stand crown closure greater than 50%?
Yes? **Meets R6 Guide definition.** No? 14.

14.Is this a multi-storied stand?
Yes? 15. No? Removed from consideration.

15.Are the mid-level canopy trees greater than 20 feet tall?
Yes? **Meets R6 Guide definition.** No? Removed from consideration.

Appendix 3 - Process For Implementing Fragmentation Model

Note: Abbreviations for commands are not displayed (for clarity of commands).
MAPS commands that "wrap" must break with a comma following a number, as shown.
For 17,000 cells, all MAPS commands were under 1 minute on MV20000.

In MOSS

1. WINDOW on area of concern.

2. SELECT and MERGE "old growth" quads within area of concern (from veg inventory). **OGxx**

3. SELECT and MERGE "other forest" quads within area of concern (from veg inventory; stands > saplings but not "old growth"). **OTxx**

4. SELECT and MERGE "non-forest" quads within area of concern (from veg inventory; natural openings plus seeds/saplings). **NONxx**

5. SELECT and MERGE "managed stands" quads within area of concern (harvested since veg inventory). **MSxx**

6. SELECT and MERGE planned and sold layer quads within area of concern. **PSxx**

7. SELECT PSxx SUbject S* (indicating sold FY 89/90). **SOLDxx**

8. SELECT PSxx SUbject *yyyyy* (yyyyy indicating the sale name or whatever you are analyzing) **PLANxx**

9. MERGE NONxx, MSxx, and SOLDxx for "Openings". **OPxx**

10. POLYCELL OTxx 2ac. **OTxx.R**

11. POLYCELL OPxx 2ac. **OPxx.R**

12. POLYCELL OGxx 2ac. **OGxx.R**

13. POLYCELL PLANxx 2ac. **PLANxx.R**

In MAPS

14. ZONE OTxx.R TO 120 ELIMINATING FOR OTxx.RZ (creates 400' buffer around "other forest" and eliminates "other forest" category).

15. RENUMBER OTxx.RZ FOR OTxx.RZR AS 15 TO 1 (assigns a value of 15 to 400' "other forest" buffer).

16. ZONE OPxx.R TO 120 ELIMINATING FOR OPxx.RZ (creates 400' buffer around "openings"and eliminates "openings" category).

17. RENUMBER OPxx.RZ FOR OPxx.RZR AS 3 TO 1 (assigns a value of 3 to 400' "openings" buffer).

18. CROSS OGxx.R WITH OPxx.RZR FOR OGxx.RC ASSIGNING 20 TO 1 THROUGH 999999, ANOT 3 ASSIGNING 3 TO 1 THROUGH 999999 AND 3 (assigns 20 to old growth where it is not in the "openings" buffers [value 3] and assigns 3 to all values that are in the buffers and in old-growth).

19. CROSS OGxx.RC WITH OTxx.RZR FOR WTDxx.R ASSIGNING 20 TO 20 ANOT 15 , ASSIGNING 3 TO 3 ANOT 15 ASSIGNING 3 TO 3 THROUGH 15 AND 15 ASSIGNING 15,TO 20 AND 15 (assigns 20 to old growth where it is not in the "other forest" buffer [value 15], assigns 3 to all "openings" buffers that are not in "other forest" buffer [value 15], assigns 3 to all values that are in both buffers and in old-growth, and assigns 15 to all values that are in the "other forest" buffer and old-growth).

20. RENUMBER WTDxx.R FOR WTDxx.RR ASSIGNING 1 TO 20 ASSIGNING 2 TO 15 , ASSIGNING 3 TO 3 (assigns 1, 2, and 3 to 20, 15 and 3 for display purposes, only. Use AUDIT and HEWLETT).

21. CONSTANT OGxx.R ASSIGNING 0 FOR BACKxx.R (makes background of 0 for use later).

22. COVER BACKxx.R WITH WTDxx.R FOR WTDxx.RC (type 8 map) (creates a continuous map for SCANing).

23. SCAN WTDxx.RC AVERAGE MATRIX 5 FOR SCANxx.R (type 8 map) ("neighborhood" analysis with 1/8 mile radius).

24. RENUMBER WTDxx.RC FOR ZERO.R ASSIGNING 1 TO 1 THROUGH 999999 (type 8 map) (creates "multiplier" map, assigning 1 to all old growth).

25. MULTIPLY SCANxx.R BY ZERO.R FOR DONExx.R (type 8 map) ("cookie cuts" old growth out of the "average" map).

26. SLICE DONExx.R INTO 20 FOR SLICExx.R(type 7 map)(creates a discrete map out of continuous with values of 1-20).

27. RENUMBER SLICExx.R FOR FINALxx.R ASSIGNING 0 TO 1 (reassigns 0 to background).

28.TOTAL FINALxx.R BY PLANxx.R FOR FRAGxx (outputs table of values for each unit or sale, filename = FRAGxx).

Outputs

Hewlett OGxx and OTxx to show old growth, "other" forest, and created and natural openings.

Hewlett raster map of WTDxx.RR to show assigned values to old growth stands.

PRINT (within MAPS) of WTDxx.RR to show digital format of above map.

PRINT (within MAPS) of SLICExx.R to show digital format of "neighborhood" analysis.

AREA of WTDxx.R to show acres of each value.

AREA of SLICExx.R to show acres of each value after "neighborhood" analysis.

FRAGxx displays the average and total "fragmentation cost" of each unit.

After these steps, you only need to keep FINALxx.R and the original rastered maps, delete the intermediate maps.

SPATIAL DATA PROCESSING USING MAP OVERLAY AND STATISTICAL SYSTEM AND PRIME'S COMMAND PROCEDURE LANGUAGE

As Presented by Mark Steven Koski
At The 1990 MOSS User's Conference
In Portland, Oregon

Oregon's Bureau of Land Management (BLM) is in the process of developing a 7 million acre geographic data base, 2.4 million acres of which are BLM land. The resources found on this land include timber, fisheries, minerals, recreation and wildlife habitat. This data base, the Western Oregon Digital Data Base (WODDB), was designed to help, effectively, manage these valuable resources.

WODDB's base maps are being compiled on various scales from 1:12,000 to 1:2,000,000 and contain over 75 resource themes. The spatial resource information contained in WODDB must be available for analysis. Since we no longer make maps by hand, Resource Specialists and Managers must be able to input, analyze, output and save their resource data. This is done by using GIS (Geographic Information Systems). We have now left the colored pencils, mylar and dot counters to the PRIME and/or personal computers.

Computer mapping is fast, efficient and here to stay. As a GIS Coordinator I believe in the program and am confident of it's results. The one big problem area I have noted is the wide range of skill levels manifested by the users of the PRIME computer and MOSS software. Many times frustration and/or inability to use the system has occurred, dependent upon the user's computer literacy. I have therefore developed two aids (CPLs) that help make WODDB user friendly.

WHAT IS A CPL?

The PRIME CPL User's Guide explains that a, "CPL is the PRIME Command Procedure Language ... One common use of procedure language is to automate frequently-used sequences of command operations. Rather than invoke each command operation from your terminal, you specify the sequence of command operations once in a procedure language program. When you execute the procedure language program, it invokes all of these command operations in the sequence you specified."

The two CPLs I have developed, SALEPLAN CPL and TRANS1 CPL, were designed to meet the Resource Specialist's need to have maps available for their on the ground work. Both CPLs build maps in the Resources Specialist's active table and MOSS work area. From these maps they can locate the point of a traverse and produce a report using a FOI (Forest Operational Inventory) theme as to stand condition. This report can be linked back to the plot it produces. TRANS1 CPL is a "front-end" to the XLATE CPL (that exports MOSS maps to DXF (drawing interchange files) for use in AUTO CAD). This CPL takes portions of the MOSS maps, cuts them and renames them so they can be used by the XLATE Program. In other words TRANS1 CPL makes XLATE user friendly.

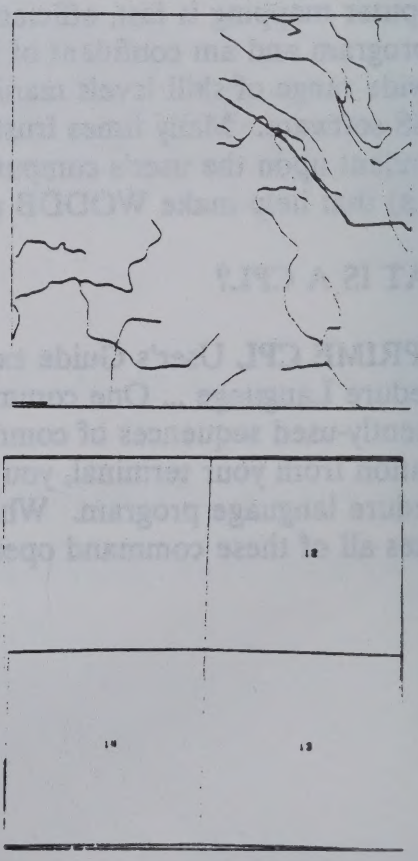
WHAT DO THEY ACTUALLY DO?

At the beginning of both CPLs on-line help is given to the computer user to assist in the selection and entering of MOSS project, township and section number. Both CPLs take township based information, intersect and LPover (line and polygon overlay) them by user defined sections. They then intersect the sections with the Forest Operational Inventory and Land Ownership. One at a time each CPL selects a piece of data out, renames it and stores it in the active table and work area. At this time the LPover command occurs which "cookies-cutters" (see Diagram #1) sections into their Transportation and Hydrography themes. This data is then again taken out, renamed and stored in the active table and work area. From this point on the 2 CPLs go into their separate functions.

DIAGRAM #1

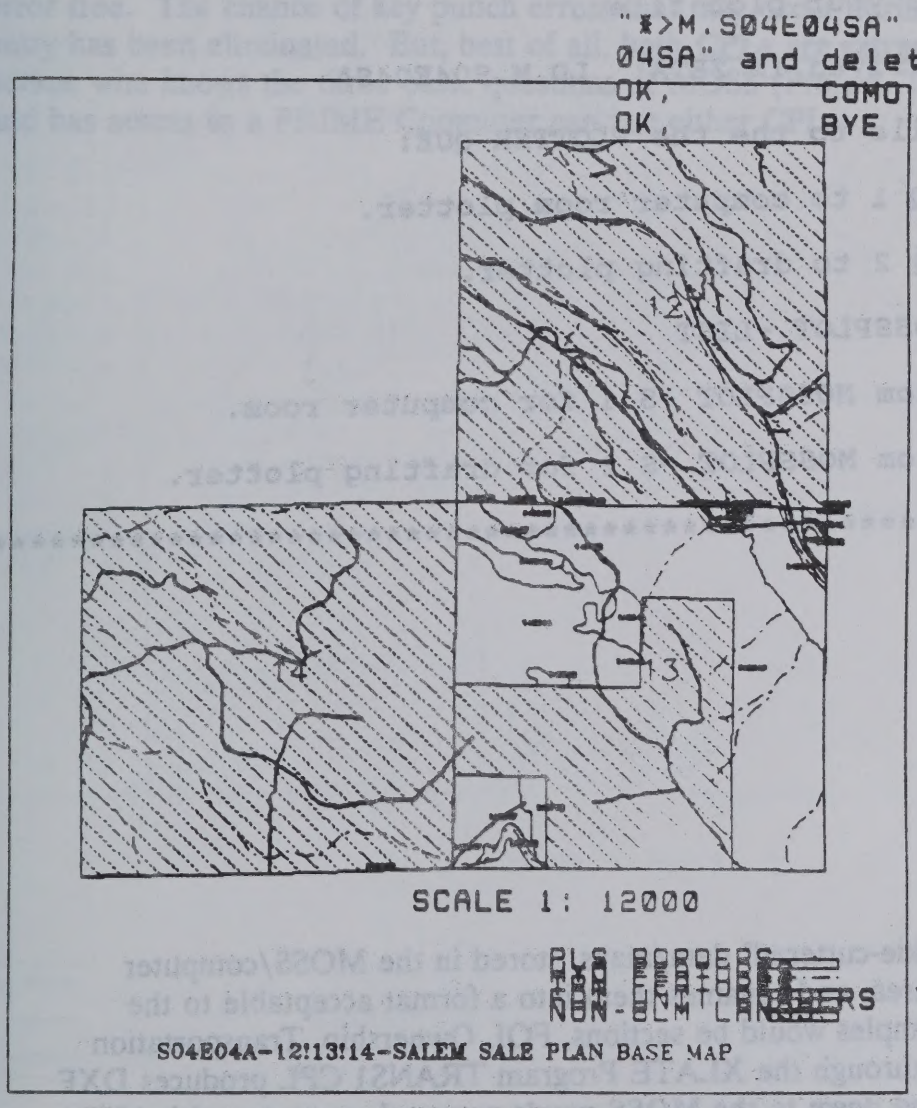
ORIGINAL MAP

COOKIE-CUT MAPS



SALEPLAN CPL can now produce a report from the FOI theme as to stand condition. The next command is penplot, which has historically produced error-free pen plot files. The pen plots are then moved from the MOSS user area to ZETA (a holding pen for plot files) to be stored. At this point one of SALEPLAN CPL's best features occur. The MOSS/computer user can now see the contents of the plot file command, **the actual map** (see Diagram #2), on his/her terminal. This allows the user to visually check the map to confirm accuracy of both the plot file and location of the MOSS map. After the ZETA move has taken place specific on-line instructions (see Diagram #3) have been incorporated to instruct the individual MOSS/computer user on how to send their plot files to the PEN PLOTTER.

DIAGRAM #2



190

DIAGRAM #3

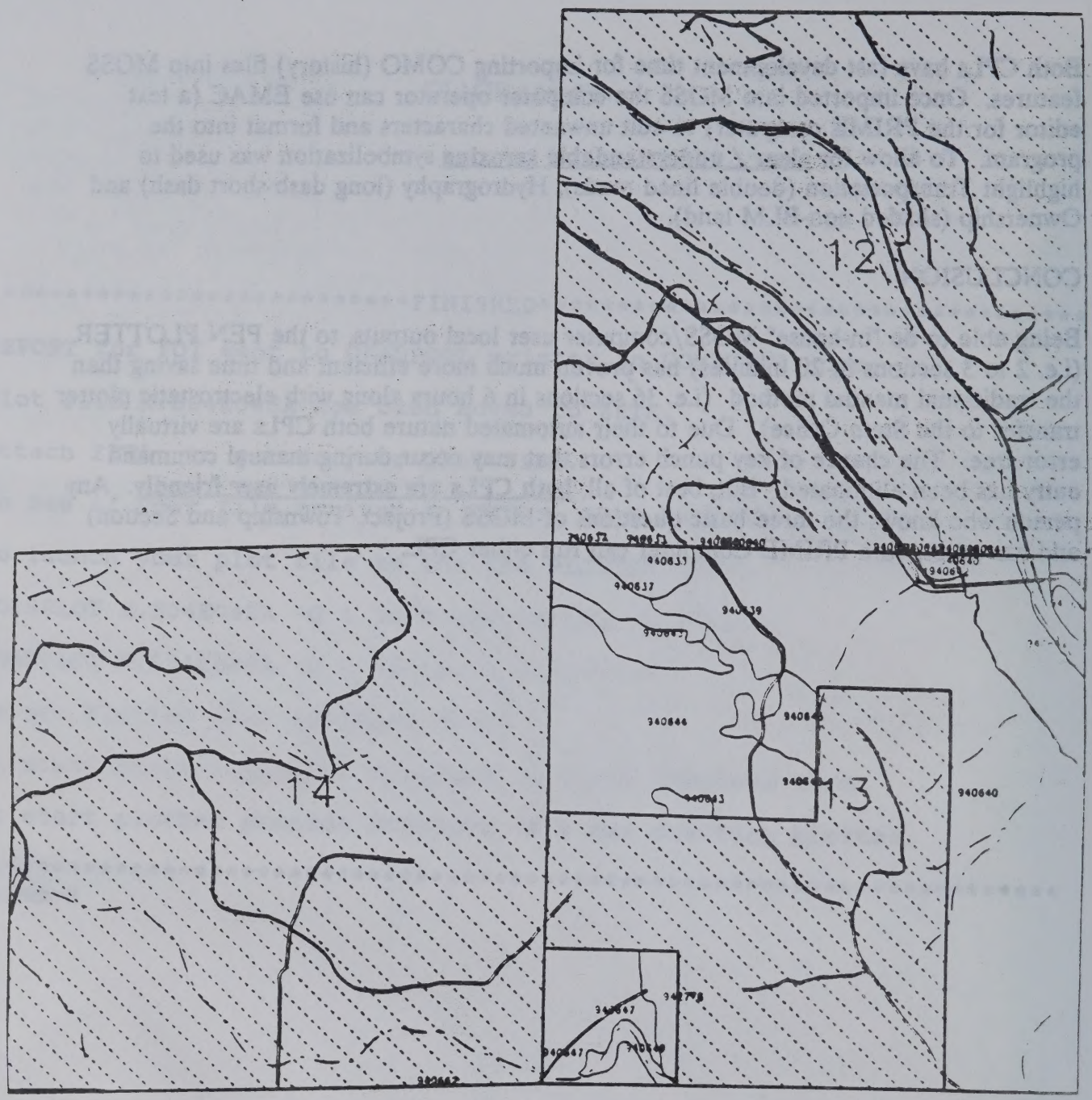
```
**************************FINISHED*************************************
REPORT for FOI sent to OKISPOOL printer in COMPUTER room.
Plot file M.S04E04SA has been moved to ZETA.
Attach ZETA  to get to your plot file.
To see if your file arrived in ZETA:  LD M.S04E04SA
To launch your plot file to the the PLOTTER QUE:
MOSSPLOT M.S04E04SA -Q 1 to computer room plotter.
MOSSPLOT M.S04E04SA -Q 2 to drafting plotter.
To see Plotter Que: MOSSPLOT -LIST
To start plotter phantom MOSSPLOT -S 1 for computer room.
To start plotter phantom MOSSPLOT -S 2 for drafting plotter.
************************************************************************
Salem->
```

TRANS1 CPL takes the "cookie-cuttered" data/maps, stored in the MOSS/computer user's active table and work area, and renames them into a format acceptable to the XLATE Program. Name examples would be sections, FOI, Ownership, Transportation and Hydrography. Once fed through the XLATE Program TRANS1 CPL produces DXF files that can be **PRIME linked down to the MOSS user's personal computer with AUTO CAD.**

Both CPLs have fast development time for importing COMO (history) files into MOSS features. Once imported into MOSS the computer operator can use EMAC (a text editor for the PRIME computer) to edit unwanted characters and format into the program. To allow for clear / understandable xeroxing symbolization was used to highlight Transportation (double lined roads), Hydrography (long dash-short dash) and Ownership (shaded non-BLM land).

CONCLUSION -

Being able to do "in-house" MOSS/computer user local outputs, to the PEN PLOTTER (i.e. 2 to 3 sections in 20 minutes) has proven much more efficient and time saving than the traditional manual method (i.e. 36 sections in 6 hours along with electrostatic plotter transfer to the State Office). Due to their automated nature both CPLs are virtually error free. The chance of key punch errors that may occur during manual command entry has been eliminated. But, best of all, both CPLs are extremely user friendly. Any person who knows the three basic questions of MOSS (Project, Township and Section) and has access to a PRIME Computer can run either CPL.



SCALE 1: 12000

PLS BORDERS
HYD FEATURES
TRN FEATURES
FOI UNIT BORDERS
NON-BLM LANDS

S04E04A-12!13!14-SALEM SALE PLAN BASE MAP

SUMMARY FOR MAP S04E04SFOI

ITEM	SUBJECT	ES^	AREA
1	940633	D3-1920	0.001
2	940637	D4=1800	0.001
3	940639	D3=1930	0.000
4	940640	D3-=1920	0.000
5	940640	D3-=1920	0.000
6	940640	D3-=1920	0.001
7	940640	D3-=1920	0.000
8	940641	NW	0.001
9	940642	NU	0.000
10	940647	D3-=1920	0.003
11	940662	D3H-=1910	0.007
12	940633	D3-1920	8.798
13	940637	D4=1800	11.073
14	940639	D3=1930	12.983
15	940640	D3-=1920	179.181
16	940640	D3-=1920	1.964
17	940640	D3-=1920	1.679
18	940640	D3-=1920	2.597
19	940641	NW	26.388
20	940642	NU	2.307
21	940642	NU	1.373
22	940643	D1-1950	11.239
23	940643	D1-1950	2.611
24	940644	D2-=1950	74.237
25	940645	R D4-1800//D3H-1910	10.802
26	940646	D2-=1940	9.372
27	940647	D3-=1920	28.355
28	940649	PL D1RA-=1964	4.287
29	940650	NH	5.796
30	942776	X 1984	7.549

```
/*  SALE_PLAN.CPL
/*  Title: SALE_PLAN
/*  Authorized by: M. KOSKI SALEM DISTRICT OFFICE
/*
/*  WRITTEN BY: Mark S. Koski EMAC ENTRY
/*  IDI Roseburg revised user inerface
/*  Written by: A GANG OF YOUNG GUNS
/*  BOB HIPPLE 09/01/90 ADD REPORT FOR FOI
/*  MARK KOSKI 10/01/90 FIX LPOVER OF TRN AND HYD THEMES
/*  MARK KOSKI 10/02/90 ONLINE HELP FOR MOS PROJECTS, TOWNSHIPS
/*    and SECTION.
/*  MARK KOSKI 10/02/90 ONLINE HELP FOR PENPLOTTING (MOSSPLOT and
/*    PRIMOS COMMANDS)
/*
/*
/*
/*
/*  Themes used in this cpl:
/*  PLS=SU BY SECTION
/*  HYD=ALL
/*  TRN=\**TRZ**
/*  FOI=\NULL
/*  OWN=SU NULL TO SHADE NULL ON PLOT
TYPE
TYPE ============================================================
TYPE *****          VERSION 2.10 SALEM RELEASE            *****
TYPE ============================================================
TYPE
TYPE *****         SALE PLAN MAPPING and PENPLOT          *****
TYPE
TYPE *****   This CPL will only work on WODDB townships   *****
TYPE
TYPE ============================================================
&s home := [dir [pathname x]]
/*&args proj; twp; sec
TYPE
TYPE PROJECT= CLACKAMAS, SANTIAM, TILLAMOOK, YAMHILL, ALSEA or SHARED
TYPE
&s proj := [response '  Please enter the MOSS project ']
TYPE
&s twp := [response ' and the township name.(Ex: S04E04) ']

TYPE              *** SECTIONS ***
TYPE
TYPE               6  5  4  3  2  1
TYPE               7  8  9 10 11 12
TYPE              18 17 16 15 14 13
TYPE              19 20 21 22 23 24
TYPE              30 29 28 27 26 25
TYPE              31 32 33 34 35 36
TYPE
&s sec := [unquote [response ' also the township section subjects(Ex: 12!13) '
TYPE
&s plt := [response ' and the plot indentifier(Ex.  ONE number or letter code
TYPE
TYPE                      TERMINAL TYPE
TYPE                      0 = GraphON, Visual 500
TYPE                      1 = Pericom or Emu-Tek
```

```
TYPE
&s ter := [response ' terminal type enter 0 or 1  ']
/*&do twp &list %twp_list%
    or ; down moss
    delete m.%twp%(s%plt% s%plt%.log) -nq
    delete %twp%sale.como
    como %TWP%SALE.como
    date -vfull
    &data MOSS %proj% SYSTEM
       OPEN %PROJ%
       FREE ALL
       PAGE 300
       TERM %ter%
       DELETE %TWP%SPLS Y
       DELETE %TWP%SOWN Y
       DELETE %TWP%SFOI Y
       DELETE %TWP%SHYD Y
       DELETE %TWP%STRN Y

       LIST MAPS %TWP%*

       SELECT %TWP%PLS SU %sec%

       WINDOW 1

       SELECT %TWP%OWN SU NULL
       SELECT %TWP%FOI SU \NULL
       SELECT %TWP%HYD ALL
       SELECT %TWP%TRN SU \**TRZ**

       INTERSECT 1 2
       %TWP%SOWN
       Y
       0
       6
       1
       SALE_PLAN
       DATE
       INTERSECTION OF PLS/OWN
       Y

       INTERSECT 1 3
       %TWP%SFOI
       Y
       0
       6
       1
       -1
       SALE_PLAN
       DATE
       INTERSECTION OF PLS/FOI
       Y

       LPOVER 1 4
NO
%TWP%SHYD
YES
0
4
       SALE_PLAN
```

```
        DATE
        LPOVER OF PLS/HYD
        100.0000
        Y

        LPOVER 1 5
        %TWP%STRN
        YES
        0
        4
        SALE_PLAN
        DATE
        LPOVER PLS/TRN
        100.0000
        Y

        SAVE 1 %TWP%SPLS
        FREE ALL

        SELECT %TWP%SPLS ALL
        SELECT %TWP%SHYD ALL
        SELECT %TWP%STRN ALL
        SELECT %TWP%SFOI ALL
        SELECT %TWP%SOWN ALL
SYSTEM
DELETE FN%TWP%S%PLT%
BY
REPORT 4
FN%TWP%S%PLT%
Y
Y
Y
3
ES^
1
SYSTEM
OKISPOOL FN%TWP%S%PLT%
BYE
WI 1
PENPLOT
1 2 3 4 5
%TWP%S%PLT%
12000
Y
12000

Y
N
Y
N
%TWP%%PLT%-%SEC%-SALEM SALE PLAN BASE MAP
N
N
1,2
.3,12
0
NE
1
1
```

```
N
PLS BORDERS
N

2
2
2
HYD FEATURES

3
Y
6
.02,.5
TRN FEATURES
N
1,10
.07,12
0
NE
4
4
N
FOI UNIT BORDERS


1
Y
1
135
.2
1
NON-BLM LANDS

      ER
      SYSTEM
      SHOW M.%TWP%S%PLT%
      MOVE M.%TWP%S%PLT% ZETA>== -NO_QUERY
      COMO -E
      BYE
      BYE

&end


TYPE
TYPE  ****************************FINISHED*************************************
TYPE
TYPE     REPORT for FOI sent to OKISPOOL printer in COMPUTER room.
TYPE
TYPE     Plot file M.%TWP%S%PLT% has been moved to ZETA.
TYPE
TYPE     Attach ZETA  to get to your plot file.
TYPE
TYPE     To see if your file arrived in ZETA:  LD M.%TWP%S%PLT%
TYPE
TYPE     To launch your plot file to the the PLOTTER QUE:
TYPE
TYPE     MOSSPLOT M.%TWP%S%PLT% -Q 1  to computer room plotter.
TYPE
TYPE     MOSSPLOT M.%TWP%S%PLT% -Q 2  to drafting plotter.
```

```
TYPE
TYPE      To see Plotter Que:  MOSSPLOT -LIST
TYPE
TYPE      To start plotter phantom  MOSSPLOT -S 1 for computer room.
TYPE
TYPE      To start plotter phantom  MOSSPLOT -S 2 for drafting plotter.
TYPE
TYPE  ************************************************************************
a %home%
&return
```

AN OVERVIEW AND EVOLUTIONARY HISTORY OF THE HARDWARE CONFIGURATION AND NETWORK TOPOLOGY OF A LARGE SCALE DISTRIBUTED GEOGRAPHIC INFORMATION SYSTEM

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by

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ABSTRACT

In March of 1986, Infotec Development, Inc. was awarded a contract to provide data acquisition (digitizing) and facilities management services to the Oregon/Washington Office of the Bureau of Land Management. The goal: to develop a computerized Geographic Information System in order to provide BLM a more accurate and timely means to better manage the vast timber, recreational, scenic, and other resources on BLM owned lands in western Oregon.

This paper provides the audience with a historical overview of the evolution of the hardware configuration and network topology which support this massive undertaking.

ABOUT THE AUTHORS

Byll Kreil joined Infotec in September of 1988, with over eight years of Operations Management, Programming, and Systems Analysis experience. All of his data processing experience has been in the large scale PRIME superminicomputing environment, including large database and distributed network systems.

His prior experience includes field engineering, performing hardware maintenance on PRIME 50 series processors for a third party vendor. Byll has completed several PRIME Customer Education courses, including System Administration.

Mark Blum has been with Infotec since January 1989 as a Communications/ Network Specialist. Mark posesses over eight years of communication and networking experience. Prior to Infotec, Mark was a Test Center Supervisor with Hewlett-Packard and served thirteen years active duty in the U.S. Coast Guard as a Radar Technician/System Administrator.

INTRODUCTION

Infotec Development, Inc. began its relationship with the Bureau of Land Management (BLM) in early 1986. At that time, BLM management forsaw the need to increase the accuracy of its land management data and enhance the timeliness in which analysis of this data could be generated. The obvious solution was to develop a computer based Geographic Information System (GIS). Since the targeted area of BLM owned lands for this project were those located in western Oregon, the project came to be known as the Western Oregon Digital DataBase (WODDB).

The WODDB database is comprised of information for all BLM owned lands in the five western Oregon Districts. These include: Salem, Eugene, Roseburg, Coos Bay, and Medford. A total of 470 townships, each with a possibility of 80 themes were involved. Obviously, this would be a massive amount of data to capture and store!

BLM had been using MOSS software in other Bureau applications and had adopted it as a standard. This was the choice for the WODDB application as well.

The Department of the Interior (USDOI) had an existing contract with Prime Computer to provide hardware to USDOI agencies. BLM chose the Prime platform due to this existing availability.

This paper is divided into two sections. The first section documents the evolution of the Prime hardware platforms at the Oregon State Office and the five westside District Offices. The second section describes the evolution of the networking between these six sites.

WODDB/GIS SYSTEM HARDWARE COMPONENTS

1. Initial System Configuration

The initial Prime hardware configuration for the Oregon State Office consisted of a Prime 9955 II central processor with 32MB of main memory. The initial processor supported 64 asynchronous lines. In addition, support for three synchronous (network) ports were provided.

The disk complement for this system consisted of twelve (12) 496MB fixed media disk drives and four (4) intelligent disk controllers. An additional disk controller and 770MB fixed media disk were added to provide storage for Cadastral Survey data. This disk configuration provided the OSO system with 6.62 Gigabytes of formatted storage.

A 1000 line-per-minute printer and a Calcomp 5845XP electrostatic plotter, both connected via a parallel interface, were used as output devices.

The initial system for the remaining five westside BLM District Offices consisted of Prime 4150 processors, each with 24MB of main memory. These systems each supported 16 asynchronous lines and three synchronous (network) ports apiece.

Disk storage for each District consisted of three (3) 770MB fixed media disk drives and two (2) intelligent disk controllers. This provided each District with 2.27 Gigabytes of formatted storage.

A 600 line-per-minute printer and a Calcomp model 1044 nine-pen plotter were chosen as output devices for these systems. The printer and plotter were driven by serial and parallel interfaces respectively.

These initial systems were used to begin the digitizing phase of the WODDB project. The OSO system was installed first, providing a means to begin data acquisition. District systems were left to be installed at a later date. All systems were up and operational by June of 1987, even though there was no data on the machines.

2. Upgrades From Initial Configuration

As the digitizing phase of the project continued, the 9955 processor at the OSO was quickly saturated. From the installation until September of 1989, the following hardware items were added to the OSO 9955 system:

* - An additional 16MB of main memory, bringing total system memory to 48MB.

* - An additional 48 asynchronous lines, bringing total system async lines to 112.

* - A second ETHERNET controller. Inactive at initial installation.

2. Upgrades From Initial Configuration - Continued.

As the data acquisition/digitizing phase proceeded at the OSO, WODDB data was being distributed to the District Office systems. Once distributed, each District could begin editing and verifying the preliminary data. As this processing increased at the Districts, it was necessary to upgrade the 4150 systems as well.

From their installation until September 19,89 the following items were added to the initial 4150 system at each District:

* - An additional 8MB of main memory, bring the total main memory of each system to 32MB.

* - A fourth 770MB fixed media disk drive, bringing the total formatted storage to 3.03 Gigabytes.

* - Some Districts added additional async lines:

Salem added	8	(24 total)
Eugene added	16	(32 total)
Roseburg added	0	(16 total)
Medford added	12	(28 total)
Coos Bay added	16	(32 total)

All five District Offices are currently operating in this configuration. Future hardware upgrades will be discussed later in this section.

3. State Office Processor Upgrade

With the digitizing phase of WODDB winding down and Production processing gearing up, the 9955 processor at the OSO was quickly saturated. Typically, the processor was 95 percent utilized 24 hours a day during most of 1989. In addition to 20 system background (phantom) processes, the 9955 was supporting over 30 active terminal sessions as well as up to four (4) simultaneous BATCH processes. System halts and BATCH database errors were frequent.

Fortunately, the decision was made to upgrade the OSO 9955 to a dual processor 6550 machine. At the time, the 6550 was the "flagship" of the Prime fleet - the largest Prime CPU available.

The 6550 arrived and was installed in September of 1989 along with 32 bit MOSS and an operating system upgrade to revision 22.0.1 of PRIMOS. The latter two items were also implemented at the Districts.

Installation of the processor was carefully planned. But like most of the best laid plans, there was a problem. A missing PROM chip prevented us from booting the system for three days! Since our old 9955 was in pieces in the back room, we had no easy means of recovery. Fortunately, Prime was able to finally obtain the missing part, the details of which I will not go into here.

3. State Office Processor Upgrade - Continued.

With the OSO Prime upgraded and running like a top, 32 bit MOSS and fresh PRIMOS in place, we were able to take on our greatest challenge to date - "OPERATION FEATHER" - The Northern Spotted Owl Habitat Study.

4. Recent Hardware Upgrades

In September of 1990, BLM approved and ordered an upgrade for the OSO 6550 disk storage. This upgrade, a trade in of all twelve existing 496MB fixed media disk drives for 817MB devices, is an increase of 3.03GB of formatted storage. The drives were delivered and in latestalled in October of 1990.

Also in September of 1990, BLM approved and ordered twelve (12) "helical scan" cartridge tape drives: two for each District and the OSO. These tape drives use recording technology similar to that used in home VCRs and Digital Audio Tape (DAT) decks to provide extremely high storage capacities on 8mm tape cartridges. Use of these drives provide for virtually unattended backup of large amounts of data. The capacity for the system purchased is about 2.3 GIGABYTES on a single tape!

Unfortunately, as of this writing, we have received the new tape drives but Prime is in the process of fixing a known "bug" in the controller for these systems. Installation of these new drives is being held until we receive new, upgraded controllers for all sites. This is expected to be sometime the week of December 03.

5. Future System Hardware Upgrades

Now that WODDB is entering the full Production phase, the need for prosessor horsepower is more evident than ever. It has always been acknowledged that the WODDB project is CPU as well as disk storage intensive. The experience gained during the last four years of this project has dictated the upgrade path.

As of this writing, preliminary plans for major upgrades of the District Office systems to Prime 6450 processors are in the works. The OSO is investigating the posibility of upgrading to Primes latest top-of-the-line processor, the 6650.

The WODDB project is evolving into a fully operational GIS. As this evolution progresses, the need for faster processors, more online storage, and networking solutions will increase. As state-of-the-art technologies, such as rewritable optical disk, mature these will be evaluated as a means of making WODDB more accessable and reliable.

The next section will illustrate the progress made in networking the five westside District Offices and the OSO.

WODDB/GIS STATEWIDE NETWORK TOPOLOGY

1. Initial Full Duplex Network

During the middle stage of the digitizing phase of WODDB, a network of all five Districts and the State Office was implemented. The first configuration was a point-to-point, full duplex network. Using Codex model 2382 modems operating over leased voice grade lines, the OSO was connected to the other five systems, using it and two other machines as gateway nodes. The modems, capable of operating at 19.2Kb/s, were set up in "split stream" mode, providing two 9.6Kb/s channels. One 9.6Kb/s channel was allocated to support networking of the Prime systems, the other reserved to support the BLM link to the Denver Service Center via "DATANET".

This configuration was, at best, cumbersome. Throughput, especially via the gateway nodes, was unacceptably slow. File transfers, even of small files, were taking hours! A method of reconfiguring the network using X.25 and eliminating the gateway nodes was proposed. BLM accepted the proposal and requisitioned the required hardware.

2. Implementation of X.25

In January of 1989, work began on the transition to an X.25 based network. The configuration would eliminate gateway nodes by using a Packet Assembler/Dissassembler (PAD) switch as the central point in a "star" topology. BLM purchased a Codex model 6525 PAD for this implementation. This device is capable of supporting up to sixteen (16) network channels (links) at speeds of up to 56Kb/s.

To implement the X.25 network, all connections from the District Office Systems and the OSO would be made to the PAD. The PAD would then route the traffic and establish virtual circuts for packet transfers based on the system's X.25 address configured in the PAD and Primenet networking software. All of this would be fully transparent to the user.

While implementation of an X.25 network provided better data integrity and streamlined configuration and administration, it did not improve throughput. The X.25 network was brought on line using the same Codex modems in "split stream" mode. We were still unable to attain speeds higher than 9.6Kb/s.

The X.25 network has been operating reliably for over a year. It has supported massive data transfers during the Northern Spotted Own Habitat Study. During this effort, the need for higher speed communication lines was readily apparent.

3. X.25/ETHERNET LAN hybrid configuration

In addition to the Prime 6550 level "A" system, the OSO has a Prime 2450 level "D" system. This level "D" is used to support the Geographic Coordinate Database (GCDB) project being done by the Cadastaral Survey branch.

3. X.25/ETHERNET LAN hybrid configuration - Continued.

As mentioned earlier in the hardware section, the Cadastral branch "owns" a 770MB disk drive and controller which are physically connected to the level "A". Since disk storage on the level "D" is limited (509.70MB), most of the GCDB data is stored on the level "A".

The level "D" has been added to the network configuration but it uses ETHERNET protocol instead of going through the X.25 PAD. The GCDB users may then log in to the level "A" or any of the Districts, accessing X.25 via the ETHERNET link. Additionally, the disk on the level "A" can be added remotely to the GCDB machine, making it appear as any other disk, although accessed via the network. Use of remote disks simplifies file transfer processes which would otherwise have to be performed on tape.

4. Fractional T1 - 56Kb/s communication lines

Now that X.25 has been implemented in a hybrid configuration with an ETHERNET node, the next step is to revisit the issue of X.25 speeds. As stated earlier in item 2 of this section, the current X.25 network is limited to a speed of 9.6Kb/s.

In October of 1989, BLM approved and requisitioned the required hardware and telephone line upgrades to fully support 56Kb/s X.25 communication lines. The telephone lines would be "fractional T1" channels. These would be connected in via CSU/DSU units into a Newbridge model 3630 multiplexer.

For the uninitiated, "T1" is a telecommunications protocol consisting of twenty-five (25) high-speed channels. One channel is used for transmission framing. The other twenty-four (24) channels are data channels with a 64Kb/s bandwidth. These data channels can be combined in any to effect transmission rates in fractional 64Kb/s increments up to the T1 maximum of 1.544Mb/s. Since T1 is a digital carrier system, it is extremely reliable for data transmission. It also provides a cost effective means of network speed upgrade, merely adding additional channels in 64Kb/s increments, as a network grows.

As of this writing, the Oregon State Office has begun conversion of 12 "spare" T1 voice channels to 56Kb/s data channels to support our existing X.25 configuration. The telecommunications equipment for this effort is already being installed. OSO Operations is working closely with BLM and Infotec Communications Technicians developing the implementation plan for this upgrade. The goal is to have a fully operational 56Kb/s X.25 network by January 31, 1990.

5. Future LAN/WAN Networking

As WODDB evolves into a distributed application, user accessability via networks is of key importance. This is particularly true of PC and/or workstation users.

5. Future LAN/WAN Networking - Continued.

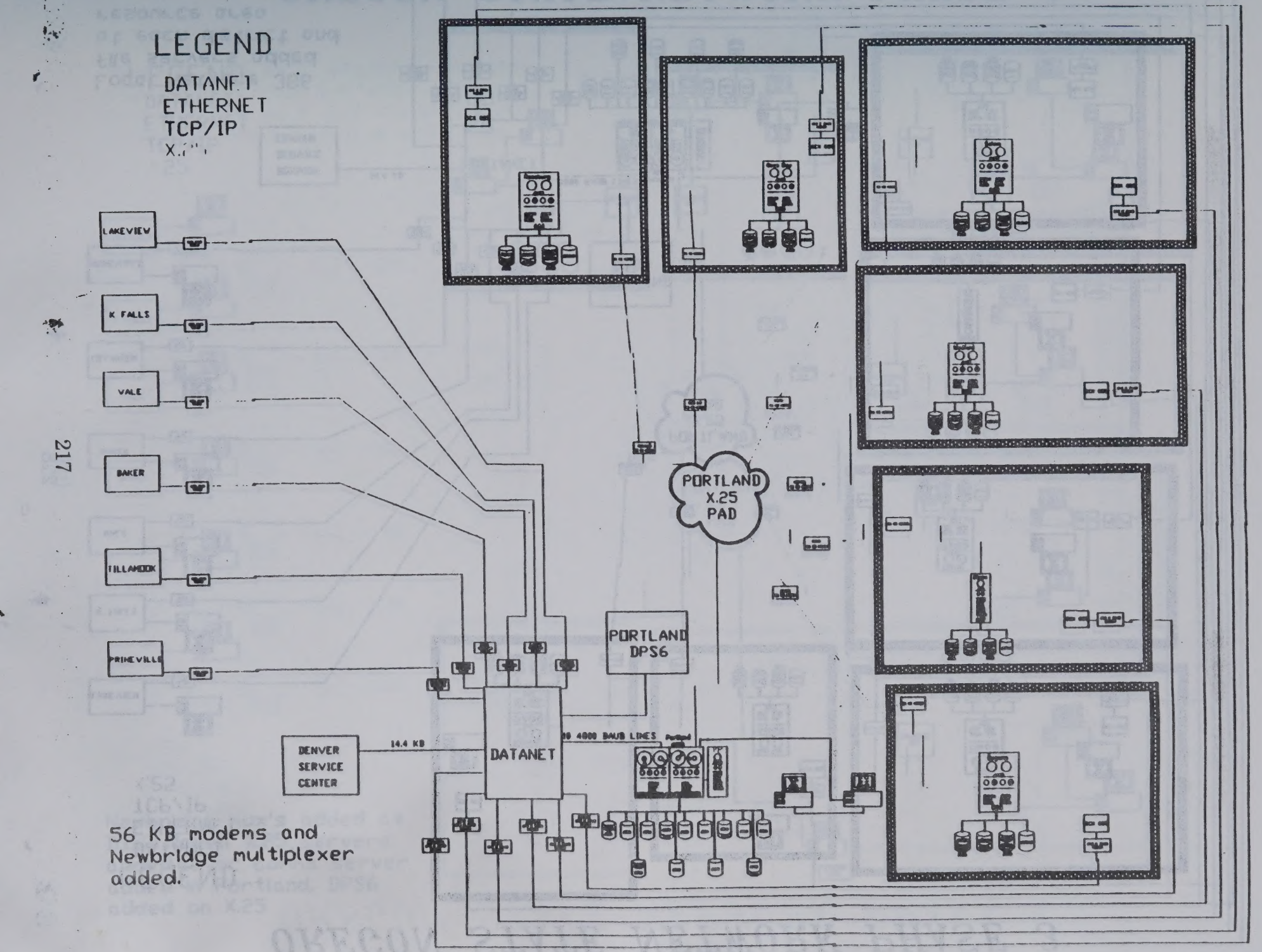
Infotec has been tasked by BLM to investigate Local Area Network software and hardware and make recommendations on possible solutions to the PC accessability issue.

Currently, areas being studied for possible upgrades include a NOVELL TCP/IP based LAN with mutiple servers. This LAN would interface to the existing X.25 network in such a way that a PC user say, in Vale, Oregon could access the Coos Bay, Oregon District Office Prime 4150 via a combination of TCP/IP and X.25. This network interface would be virtually transparent to the user.

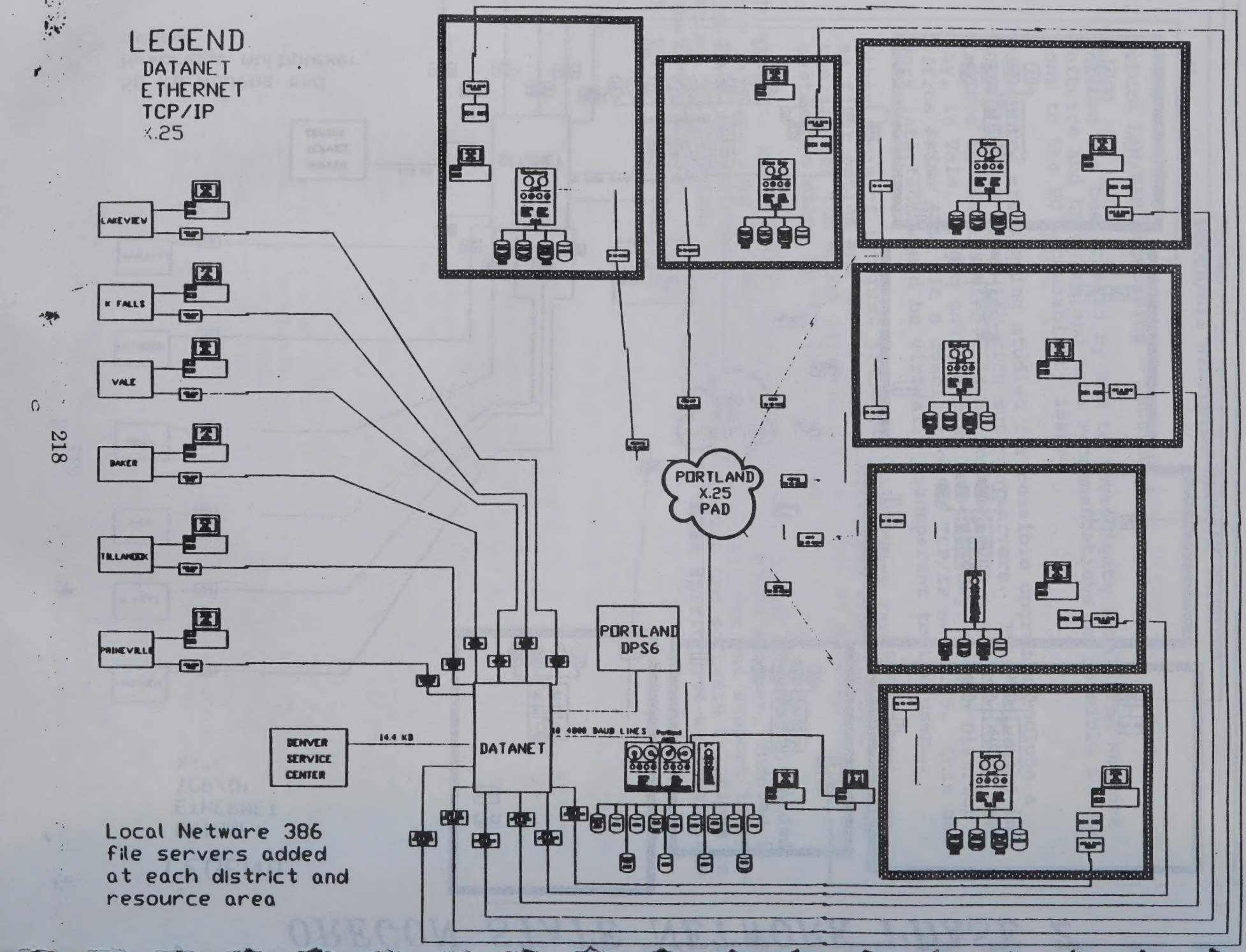
Other areas of interest are evolving network technologies, such as fiber optics and possibly even satellite transmission. Given the size of the WODDB database and the goal of a truly distributed system, no stone can be left unturned.

In the four short years since WODDB was undertaken, Infotec has aided BLM in supporting its mission and goals. As WODDB matures, Infotec is comitted to providing BLM with continued excellence and support in operating, maintaining, and recommending hardware and software solutions to the task at hand. To this end and in a "team spirit" IDI will continue to support BLM and WODDB.

OREGON STATE NETWORK PHASE 2



OREGON STATE NETWORK PHASE 3



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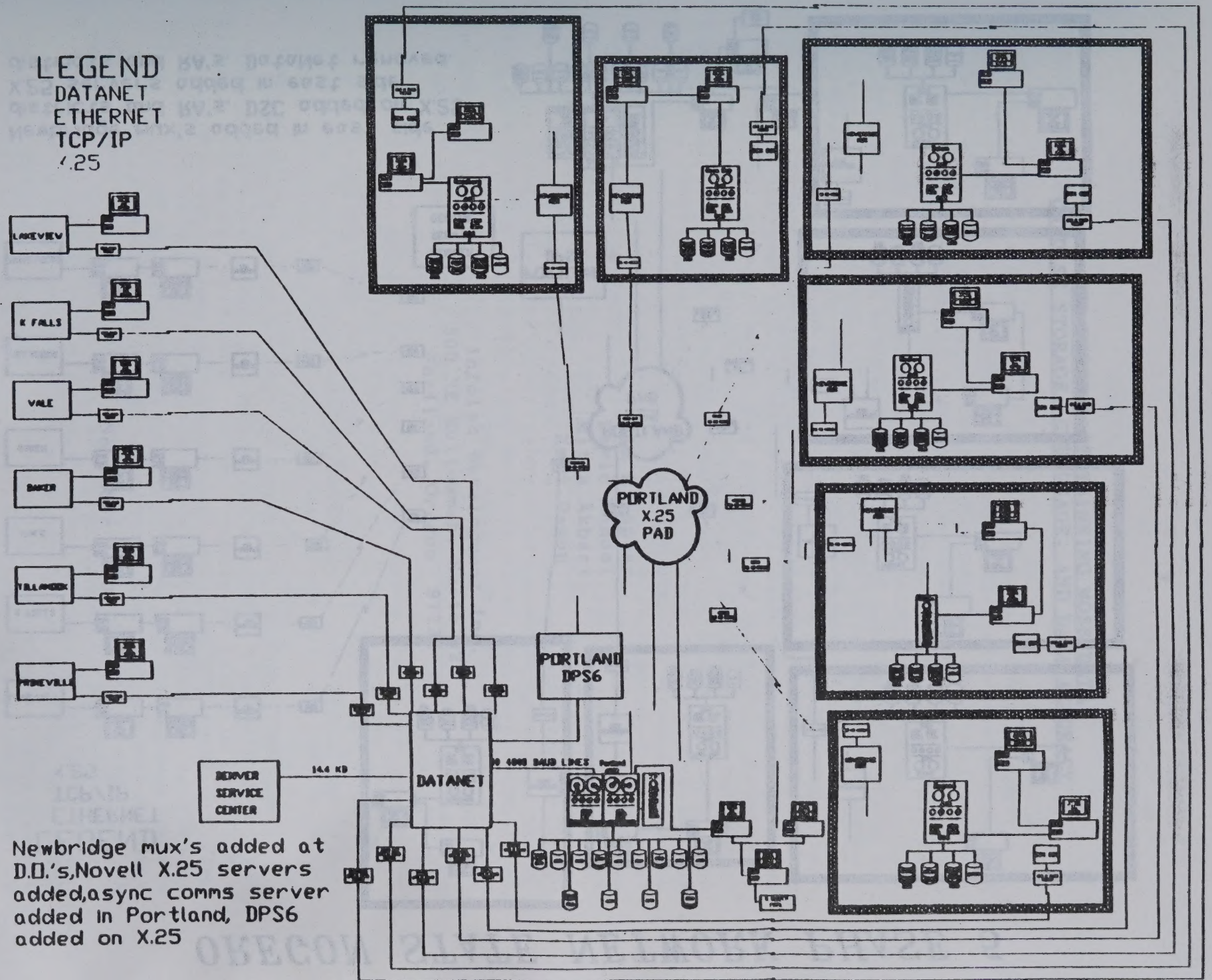
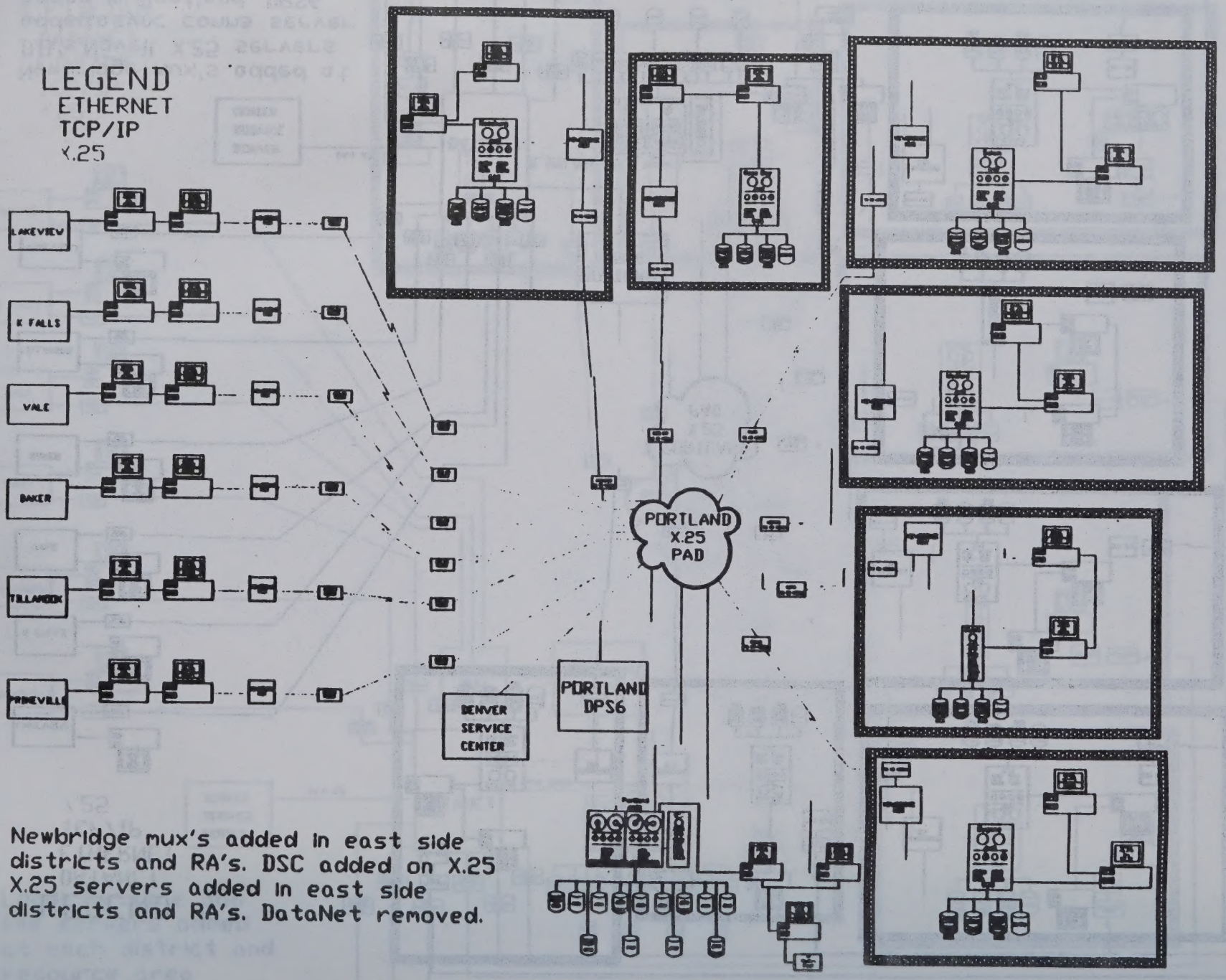


OREGON STATE NETWORK PHASE 5



Newbridge mux's added in east side districts and RA's. DSC added on X.25 X.25 servers added in east side districts and RA's. DataNet removed.

THE EFFECTS OF THINNING MOSS DATA ON DISK STORAGE, CPU USAGE, AND DATA ACCURACY

by

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INTRODUCTION

The Western Oregon Digital Data Base (WODDB) contains MOSS data for approximately 500 townships involving 80 map themes. This amount of data has resulted in the creation of over 24,000 files. Since digital data collection is usually performed at a density well above the minimum required to maintain map accuracy, it is logical to explore the option of data thinning algorithms, such as the MOSS WEED command, to reduce disk storage requirements and central processor unit (CPU) usage.

The theory behind WEEDing is quite simple. WEEDing allows for the removal of unneeded points from a line or polygon map. The algorithm takes two points and calculates a corridor that lies parallel to a line segment. The width of this corridor (WEED tolerance) is specified in meters and is infinite in length. Points are removed from the line until a point falls outside this corridor, upon which two new points are taken from the line and the WEEDing process is repeated. Data filtering techniques should be incorporated into GIS operations due to the growing number of files, and because previous studies have shown that minor degradation in digital map files does not adversely compromise map accuracy or area calculations.

Since the Bureau of Land Management (BLM) is often concerned with large scale area calculations. rather than small scale determination of precise map boundary locations, Infotec Development Inc. has begun testing the effects of WEEDing MOSS data on file size and CPU processing time.

This paper documents Infotec's preliminary findings of WEEDing selected MOSS transportation (TRB) and forest operations inventory (FOI) files.

METHODOLOGY

Four Medford District townships were selected as test models for our preliminary WEED testing. The TRB theme for these models was WEEDed at three tolerance levels; .5 meters, .75 meters and 1.0 meters. These WEEDed files were then subjected to three MOSS operations; BUFFER, LPOVER and RASTERIZE. The BUFFER size was chosen as 30 F without resolving overlap (it should be noted that resolve overlap does not function properly with large files). Rasterization was performed for type 6 maps in 20 X 20 meter cells.

The affects of WEEDing were analyzed by examining the changes in CPU time and file size (associated with each MOSS operation). Effects of WEEDing on polygon data was also addressed by WEEDing one FOI model and recording changes in map area. Mapping accuracy of WEEDed files was examined through the generation of WEEDed TRB and FOI plots at a scale of 1:12000.

ANALYSIS OF DATA

Point & file size analysis

The number of total points of the TRB models ranged from 18,131 to 65,781. WEEDing these files at increasing tolerances (.5 m, .75 m and 1.0 m) revealed that the percentage of points dropped was not constant, but dependent on the original number of points. Graph One illustrates the relationship between the percentage of total points and increasing WEED tolerance.

The two largest TRB files (33,172 and 65,781 points respectfully) showed a much wider range in point reduction including a 25% to 45% point decrease for S33W04TRB, and a 69% to 81% point decrease for S40W08TRB. Since larger files exhibited higher percentages of point deletion per WEED tolerance, the benefits of WEEDing large MOSS files to reduce disk space is easily apparent.

The two smallest TRB files (18,131 and 18,572 points respectfully) exhibited almost identical percentages of points dropped with increasing WEED tolerance. These percentages ranged from 11% at a .5 meter WEED to 33% at the 1.0 meter WEED tolerance.

File sizes of our test models ranged from 222 records to 870 records. This corresponds to just under .5 megabytes to approximately 2 megabytes of digital data (one full record of disk space on the PRIME 6550 equals about 2,048 bytes). Table One clearly reveals a direct correlation between the increasing percentages of dropped points with decreases in file size. Total records dropped a maximum of 5% to 17% at a WEED tolerance of 1.0 meters in all test models. This produced a reduction in file size of .5 megabytes between only these four TRB files. This reduction of disk space would prove significant if WEEDing was employed either throughout the WODDB project, or prior to making a new theme operational.

The last column in Table One represents the total length in miles of the TRB files. The reason this value remains unchanged with increasing WEED tolerance is due to the fact that WEED currently does not recalculate line lengths upon finishing the point reduction process. The current status of the MOSS WEED command will be addressed later in this paper.

The next phase of testing involved performing three MOSS operations on the WEEDed files.

Effects of WEEDing on BUFFER, LPOVER and RASTERIZE

The effects of WEEDing on actual MOSS operations was studied by performing BUFFER, LPOVER and RASTERIZE on each model at increasing WEED tolerances. Table Two lists the CPU usage to perform each operation and associated file sizes.

Although CPU time and file size decreased steadily in each operation using WEEDed data, BUFFER exhibited the greatest reduction in both categories as WEEDing tolerances increased. The

two largest TRB models showed the greatest reduction in CPU usage ranging from a maximum decrease of 48% to 77%. CPU time was reduced from 34% to 46% in the two smaller models. The reduction in file size varied from 17 records to 641 records using a 1.0 meter WEED tolerance.

Perhaps the strongest case for WEEDing MOSS data can be identified by analyzing the relationship between CPU time reduction and reduction in total points. Graph Two identifies a non-linear relationship between CPU reduction and the percentage of points dropped.

The two largest TRB models show that using only a .75 meter WEED tolerance, resulting in the deletion of 36% to 77% of the total points, reduced the CPU time required to perform BUFFER from 40% to over 70%. The smaller models showed a 24% to 35% reduction in CPU time when deleting 25% of the original points (.75 meter WEED).

Effects of WEEDing on area

To study the effects of WEEDing on polygon maps, S40W08FOI was WEEDed at .5 meters, .75 meters and 1.0 meters and the changes in area and total points was recorded.

Table Three reveals that the change in total area varied only 1.80 acres (.0077%) by dropping over 73% of the points using a 1.0 meter WEED. To analyze the effects of WEEDing on individual polygons, the NULL ownership was selected out of the map (SELECT S40W08FOI SUBJECT \NULL) and individual polygon areas were recorded and compared to the original map.

Table Four lists the areas and percentage difference between 10 WEEDed and unWEEDed polygons (refer to Figure One for precise polygon location). These polygons ranged in area from under 10 acres to over 400 acres. QUERYing each polygon revealed that the maximum area difference between any WEEDed and unWEEDed polygon was .5% (over 22.42 acres). Two polygons had identical areas and the total area difference between the 10 polygons sampled was .53 acres. It should be noted after selecting the NULL out of the FOI map and WEEDing the file at 1.0 meters, the total area changed by only .001% (.08 acres over 5,572.87 acres). Although additional testing of WEEDing polygon maps is needed, these preliminary results indicate that WEEDing polygon maps can be performed without degrading the quality of area calculations.

Effects of WEEDing on line length and polygon perimeters

As mentioned earlier, WEEDing files does not result in the recalculation of line lengths or polygon perimeters. This presents no problem, however, for GIS analysis since this data can be obtained by performing a simple EXPORT/IMPORT operation within MOSS. As the files are IMPORTed into MOSS, line lengths, polygon area and polygon perimeters are recalculated and can be obtained through an AUDIT of the IMPORTed file. Performing this procedure on the FOI model showed that the total perimeter was reduced by

only .80 miles (.465%) when WEEDing at 1.0 meters.

Line lengths were also obtained for the two largest TRB models WEEDed at 1.0 meters. AUDITing these IMPORTed files revealed that the length of S32W09TRB decreased by only .14 miles (.078%), and the length of S40W08TRB was reduced by .79 miles (.331%).

Effects of WEEDing on map accuracy

To graphically explore the effects of WEEDing on map accuracy, plots were created for our TRB and FOI models at a scale of 1;12,000. Additional testing was performed earlier with much smaller test models and plotted at a scale of 1:4,800. BLM is currently reviewing these plots to decide on an acceptable WEEDing tolerance for various applications and map scale.

Current status of the WEED command

As previously discussed, the current version of WEED has some minor bugs that should be corrected before used in a GIS analysis.

1) WEED currently drops line segments due to the occasional deletion of a point within two point items. This creates a "X" feature on the plot which indicates a zero-length line. Although this has been corrected by the Denver Service Center, the fixed version resides solely on the Oregon State Offices's Beta test disk.
2) WEEDing themes with multiple attributes results in the loss of the attribute files in the WEEDed map.
3) WEEDing does not recalculate the line lengths, polygon area or polygon perimeters. Users must perform an EXPORT/IMPORT procedure to update this data.

DISCUSSION

Based upon the need to reduce file size and CPU time, without compromising data accuracy, it is a logical procedure to incorporate WEEDing into a GIS analysis.

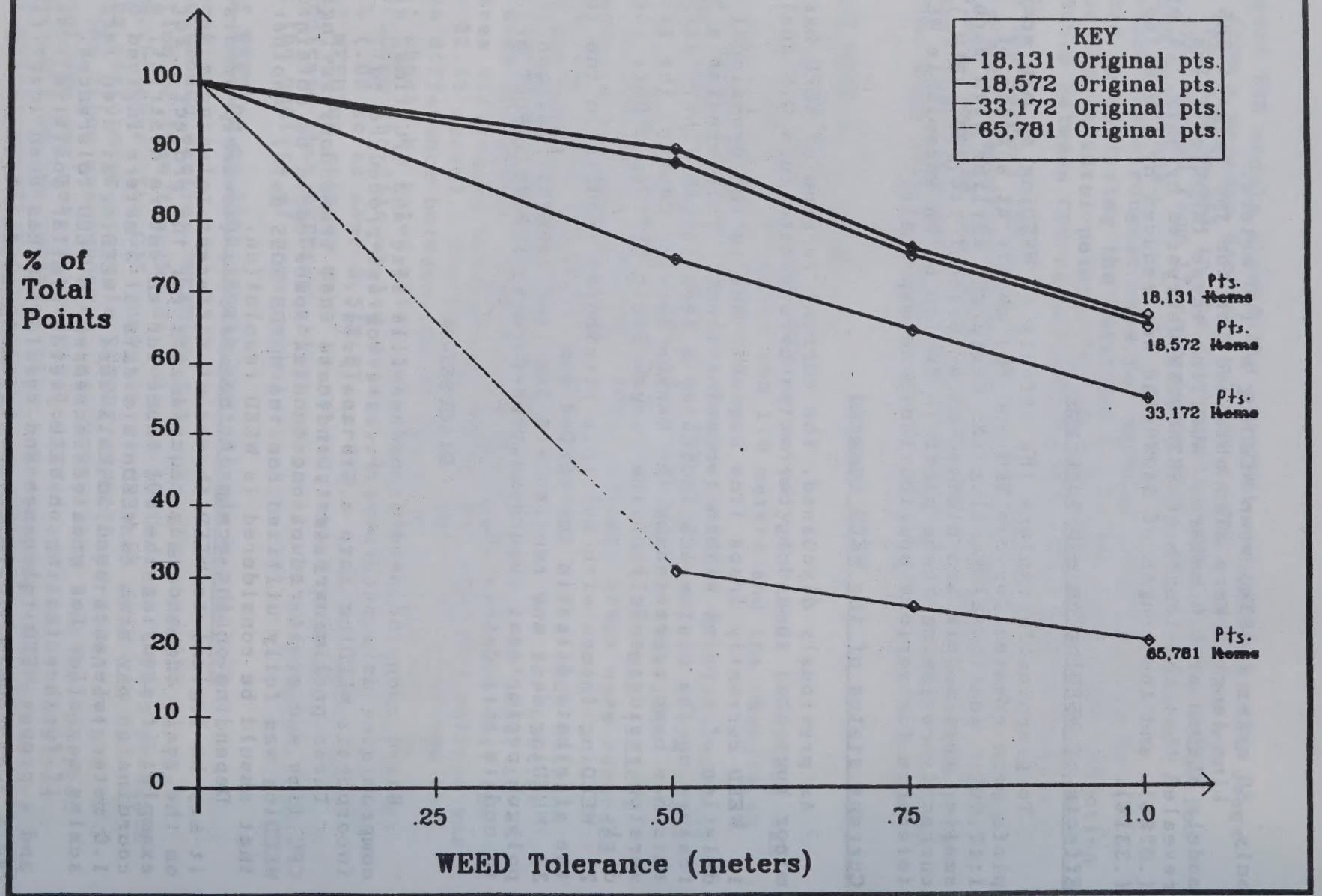
These preliminary tests indicate that tremendous savings in CPU time and great reductions in disk space could be obtained if WEEDing was fully utilized for the WODDB MOSS data. Another issue that should be considered is WEED resolution.

Depending on the scale of the analysis (township or district) it may be logical to WEED themes at different tolerances depending on the scale and accuracy requirements for the project. For example; if studying the FOI theme for an entire district, a GIS coordinator may wish to WEED this data at 5 meters instead of the 1.0 meter tolerance used in this test. WEEDing at even larger scales may allow for greater increases in WEED tolerances.

If further testing on WEED yields similar positive results, and a proper WEED tolerance and resolution has been identified, this MOSS command could be an extremely useful tool in numerous GIS applications.

Graph One:

Relationship between percentage of total points & increasing WEED tolerance with TRB data.



Graph Two:

Relationship between CPU time (%) & drop in total points on BUFFERed TRB.

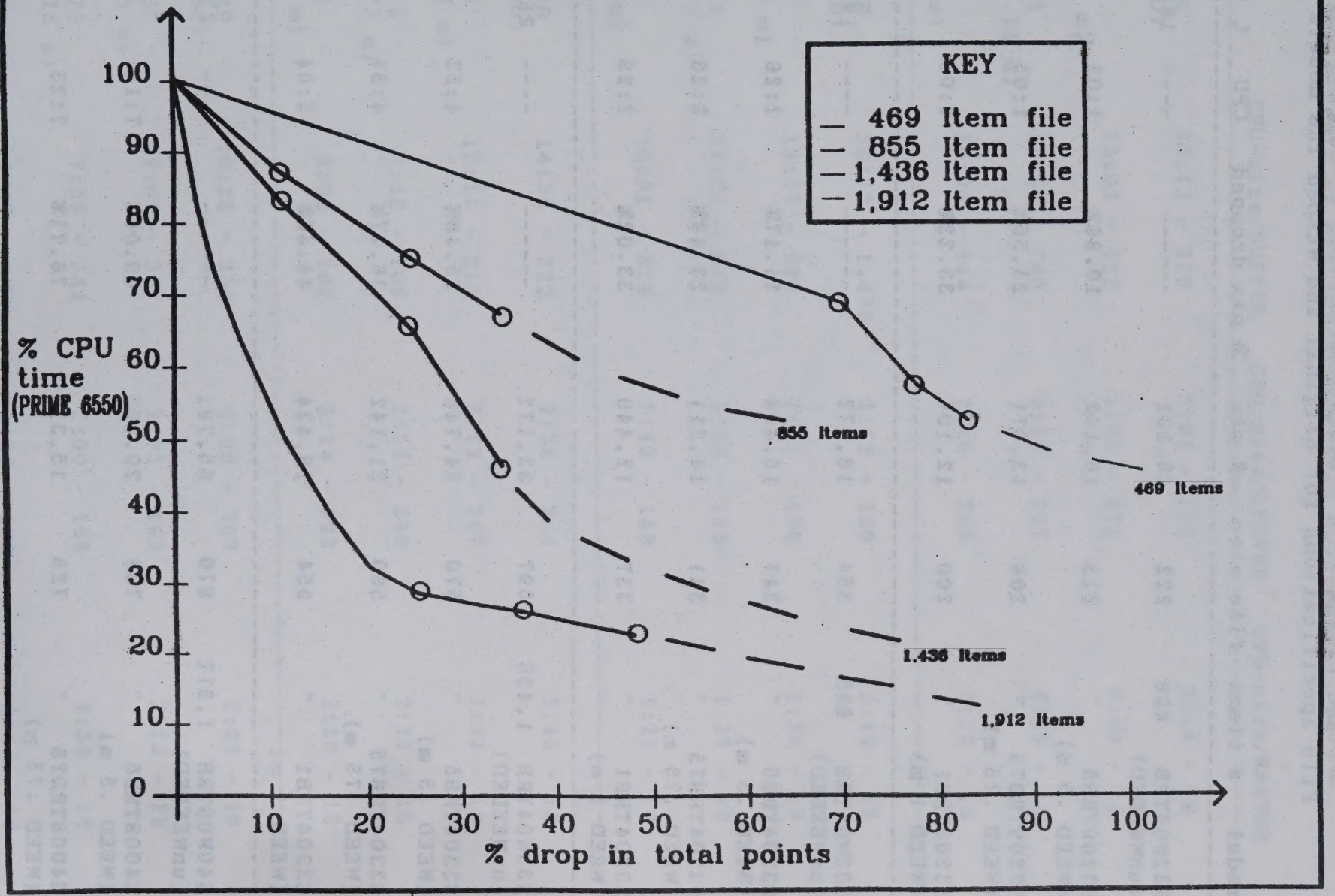


TABLE ONE:
File specifications for original and WEEDed TRB models

model	# items	file size	# pts	% pts dropped	CPU	L (mi)
S32W09TRB (unWEEDED)	469	222	18,131	------	----	180.15
S3209TRB5 (WEED .5 m)	"	215	16,162	10.86%	1:03	"
S3209TRB75 (WEED .75 m)	"	206	13,871	23.50%	1:05	"
S3209TRB1 (WEED 1 m)	"	200	12,107	33.22%	1:06	"
S32W04TRB (unWEEDED)	855	354	18,572	------	----	199.08
S3204TRB5 (WEED .5 m)	"	347	16,498	11.17%	2:26	"
S3204TRB75 (WEED .75 m)	"	341	14,211	23.48%	2:26	"
S3204TRB1 (WEED 1 m)	"	337	12,440	33.02%	2:29	"
S33W04TRB (unWEEDED)	1,436	597	33,172	------	----	268.54
S3304TRB5 (WEED .5 m)	"	570	24,746	25.40%	4:53	"
S3304TRB75 (WEED .75 m)	"	560	21,142	36.27%	4:57	"
S3304TRB1 (WEED 1 m)	"	554	18,424	44.46%	5:04	"
S40W08TRB (unWEEDED)	1,912	870	65,781	------	----	238.53
S4008TRB5 (WEED .5 m)	"	733	20,395	69.00%	7:18	"
S4008TRB75 (WEED .75 m)	"	728	15,319	76.71%	7:23	"
S4008TRB1 (WEED 1 m)	"	725	12,676	80.73%	8:15	"

note: all CPU times pertain to PRIME 6550

TABLE TWO:
The effects of WEEDing on specific MOSS operations

model	CPU-size/BUFFER	CPU-size/LPOVER	CPU-size/RASTOR
S33W04TRB (unWEEDED)	45:43 - 920	3:04 - 282	3:44 - 18
S3304AT5 (WEED .5 m)	13:03 - 822	3:04 - 271	2:50 - 18
S3304AT75 (WEEDed .75 m)	11:55 - 780	2:18 - 267	2:29 - 18
S3304AT1 (WEED 1 m)	10:44 - 744	2:19 - 265	2:13 - 18
S40W08TRB (unWEEDED)	20:10 - 1,470	2:12 - 180	5:40 - 18
S4008AT5 (WEED .5 m)	13:57 - 926	1:41 - 150	1:59 - 18
S4008AT75 (WEED .75 M)	11:27 - 862	1:39 - 149	1:37 - 18
S4008AT1 (WEED 1 m)	10:31 - 829	1:40 - 148	1:27 - 18
S32W09TRB (unWEEDed)	14:56 - 222	2:34 - 254	3:45 - 18
S3209AT5 (WEED .5 m)	12:14 - 215	2:23 - 247	3:24 - 18
S3209AT75 (WEED .75 m)	9:42 - 206	2:18 - 240	2:57 - 18
S3209AT1 (WEED 1 m)	8:08 - 200	2:14 - 193	2:40 - 18
S32W04TRB (unWEEDed)	10:26 - 354	2:06 - 203	2:28 - 18
S3204AT5 (WEED .5 m)	9:09 - 347	2:02 - 199	2:15 - 18
S3204AT75 (WEED .75 m)	7:58 - 341	2:00 - 196	1:58 - 18
S3204AT1 (WEED 1 m)	6:52 - 337	1:52 - 193	1:44 - 18

note: all buffering done at 30 F. Rastorized at 20 X 20 m cells.

TABLE THREE:
Test results of WEEDing on FOI data

model	size	CPU	AREA(acres)	# pts	% pts dropped
S40W08FOI (unWEEDed)	120	----	23,254.87	19,258	------
S40W08F_5 (WEED .5 m)	74	00:05	23,254.27	7,720	59.91%
S40W08F_75 (WEED .75 m)	68	00:07	23,253.93	6,155	68.04%
S40W08F_1 (WEED 1 m)	64	00:06	23,253.07	5,166	73.17%

note: A 1.80 acre (.0077%) difference exists between the unWEEDed FOI file and the file WEEDed at 1 meter.

TABLE FOUR:

Comparison of polygon areas between unWEEDed and WEEDed FOI
(S40W08--WEEDed at 1 meter. Area in acres)

model	polygon #	unWEEDED area	WEEDed area	% diff.
S40W08	1	30.38	30.40	.066%
	2	161.60	161.60	0
	3	14.57	14.60	.205%
	4	36.65	36.60	.137%
	5	13.33	13.30	.225%
	6	8.59	8.60	.116%
	7	22.42	22.30	.535%
	8	47.40	47.40	0
	9	402.82	402.40	.104%
	10	22.47	22.50	.133%

COMPARISON OF FINAL AUDIT TABLES FOR S40W08FOI SU \NULL
(WEEDed vs. unWEEDed)

model	perimeter (miles)	area (acres)	# points
unWEEDed	171.91	5,572.87	17,725
WEEDed (1 m)	171.11	5,572.79	4,682

It should be noted that by WEEDing this file at 1 meter the perimeter was modified by .465% (.80 miles).

Area changed by .001% (.08 acres).

* THESE MINOR CHANGES TO THE FOI FILE OCCURED AFTER DROPPING 73.59% OF THE ORIGINAL POINTS.

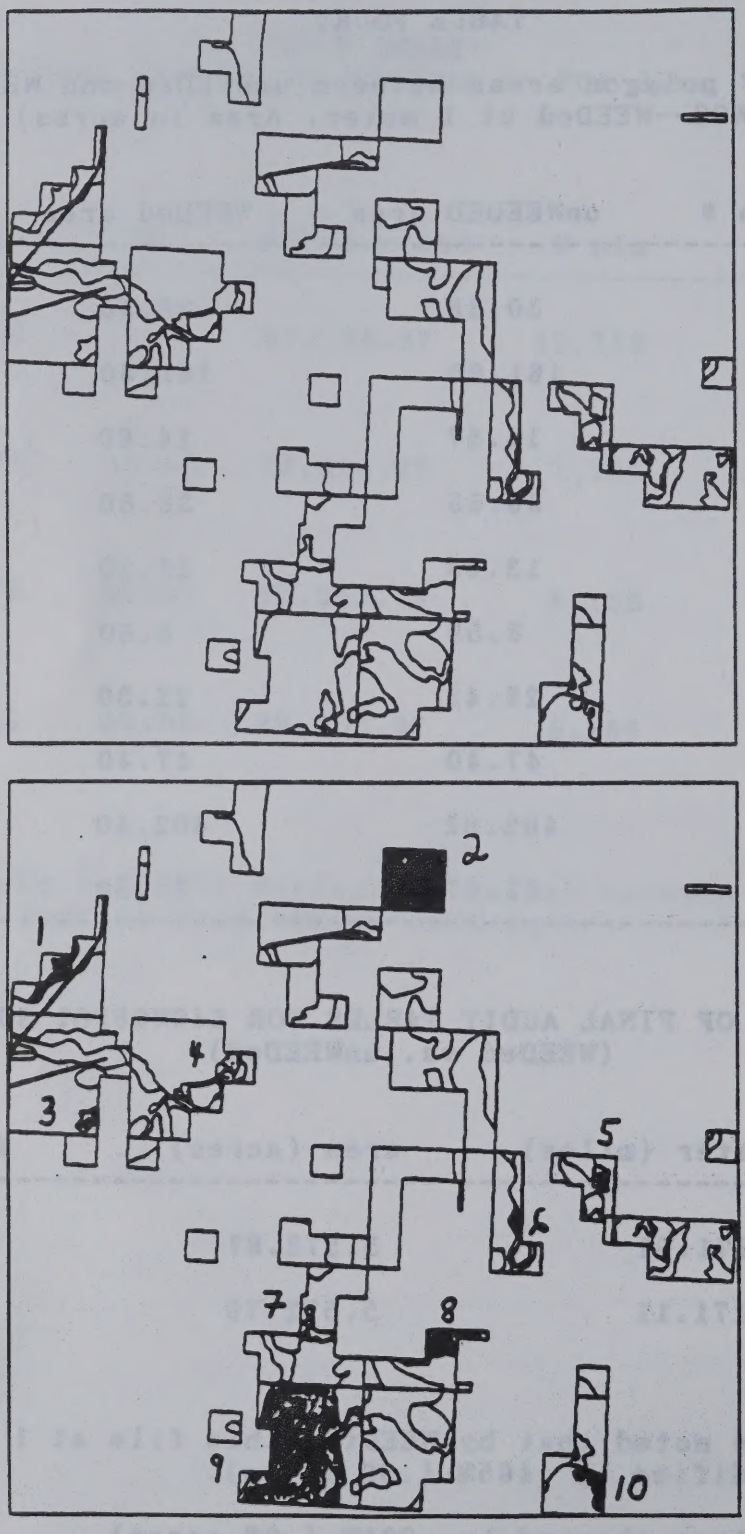


FIGURE ONE:

Plot of unWEEDed and WEEDed FOI files for S40W08 (scale 1:12,000. Shaded & numbered polygons used for area comparison test)

Making MOSS User Friendly

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Abstract

Like most older software products, MOSS has a command driven user interface requiring users to memorize a large complex command syntax and manually type in long cryptic command lines from a terminal. Software maintenance engineers have developed numerous techniques to improve existing user interfaces. In this paper, we will explore the applicability of several of these techniques to the MOSS family of software.

1. Introduction

Although Geographic Information Systems (GIS) are expensive and complex they can be extremely valuable to large land owners and planning agencies in managing resources efficiently. The federal government recognized this long ago. As a result several federal agencies have funded and created a great deal of GIS software. Among the earliest of this software was a public domain GIS package called MOSS.

MOSS has been in the public domain for well over a decade. As with most public domain products, many different developers have added to MOSS, and different versions now exist. Moreover, the original MOSS program did not provide a data capture facility to prepare MOSS data. Thus, developers created several different data capture programs for MOSS and many users consider these to be part of the MOSS system. As a result, different people mean different things when they use the term MOSS.

In this paper, we use the term MOSS Family of Software for the entire collection of programs usually used in collecting and analyzing maps in the MOSS GIS. This collection includes several data capture or digitizing programs such as:

AMS or Analytical Mapping System
: This program is available for Data General Computers and is widely used by several agencies.

ADS or Automated Digitizing System
: This program is available for Prime and Data General Computers and is widely used by the Bureau of Land Management.

LTPlus
: This program is available on Xenix and Unix based microcomputers and is widely used by the U.S. Forest Service and Soil Conservation Service. Since this program is equally useful in building data for many different GIS programs it isn't clear that LTPlus is part of the MOSS Family of Software. However, from a MOSS user's point of view it makes sense to include LTPlus in the family.

The family also includes the main map analysis programs. These consists of MOSS for analyzing vector data and MAPS for analyzing raster data. Finally, the MOSS Family of Software includes several output programs such as:

COS or Cartographic Output System
: This program is available on Prime and Data General Computers and is widely used by the Bureau of Land Management to prepare very elaborate plots of map data.

Most MOSS users also use other tools such as AutoCad, Oracle, and DBase as part of their system. However, since these are very common tools and since they are proprietary we do not consider them part of the MOSS Family of Software.

We use the term MOSS or MOSS/MAPS for the main program users invoke to analyze map data. This actually consists of two subprograms:

(1) MOSS for handling vector map data
(2) MAPS for handling raster map data

This combination is the real core of the MOSS GIS and some version of it runs on many different platforms including:

(1) Data General running AOS
(2) Prime running Primos
(3) DEC VAX running VMS
(4) Tektronix running Unix
(5) PCs running MS-DOS

From the discussion above the reader can tell that the MOSS Family of Software is very fragmented. The programs run on different hardware, using different operating systems. Some of them are command driven. Others are menu driven. Some of them work well and others have major persistent bugs. It would be an enormous undertaking to integrate the entire family of software into a single coherent system.

Thus, we have limited our work to MOSS/MAPS and our primary interest has been with MOSS/MAPS on Prime computers. Finally, this paper is only concerned with issues affecting user friendliness. Thus, for the purposes of this paper we do not consider certain well known numerical problems to be serious deficiencies since they irrelevant to the user friendliness of the package.

2. Current Deficiencies and Possible Solutions

The MOSS portion of the MOSS/MAPS program has an old fashion command driven user interface. It requires a good deal of typing and is cumbersome, but it prompts the user for information and is reasonably friendly. The MAPS portion is also a command driven user interface. Since it does not prompt the user for missing parameters, it requires the user to remember a detailed command syntax for each command. Moreover, MOSS and MAPS have many inconsistencies. They use different syntaxes and MOSS and MAPS commands have several conflicts in command names and uses. In short, the MOSS/MAPS program has the following deficiencies:

- Lack of consistency
- Requires memorization of complex command syntaxes
- Command entry requires too much typing
- Lacks a macro language
- Lacks the ability to access map catalog information
- No ability to access maps in different MOSS projects or directories during one MOSS/MAPS session
- A user can not easily detach long time consuming processes from his or her terminal.
- One can not plot or print from within MOSS/MAPS

Some of these deficiencies are very deep in MOSS/MAPS, and it would require a major rewrite to solve all of these. Since the authors do not have the resources for a major rewrite, we have been looking for ways to improve the MOSS/MAPS user interface enough to resolve a few of these deficiencies. Among the solutions we have considered are:

- Shell macros written in CPL, CLI, etc.
- Down loads of terminal function keys with MOSS/MAPS commands
- Implementation of Prime's command line editor in MOSS/MAPS
- EZMOSS
  (This is a mouse driven system based on MS Windows and other commercial software.)
- Other Systems
  X-EZMOSS, The MOSS Shell System, RD_ECL/Emacs
  (These are other ways of implementing EZMOSS which have been considered.)

3. Shell Macros Written in CPL, CLI, etc.

All of the operating systems supporting MOSS/MAPS have fairly powerful shell languages. These allow users to create files or shell programs containing MOSS commands. One can then execute these whenever one wants without entering the commands manually. All of these shell languages support variables, looping, and decision branching. Prime's shell language is called

CPL and it is a very full language supporting string manipulation, file I/O, and most commonly used flow structures. Users normally use an editor and normal software design techniques to produce these shell programs. Shell programs written this way can be very powerful. Sophisticated programmers can produce even more powerful systems by writing programs which themselves produce and execute highly customized shell programs.

Writing and using shell programs:

- Reduces the need for repetitive typing
- Makes it practical to run many MOSS processes in the background
- Helps maintain consistency in applying the same process to multiple sets of maps

Moreover, shell programs are popular because they can be written without modifying MOSS itself.

On the other hand, the shell programs have a number of weaknesses. They are very operating system dependent. MOSS/MAPS has unattractive terminal I/O and using shell programs only makes this worse. Shell programs can be very complex. A certain level of sophistication is required by anyone writing shell programs and elaborate shell programs require the support of highly skilled software professionals. Finally, even the best shell languages lack the dynamic decision making capability required to make MOSS truly friendly.

4. Down Loading Terminal Function Keys with MOSS/MAPS Commands

Emacs is a well known text editor written at MIT many years ago. It runs on many different platforms and is very powerful. The Bureau of Land Management got Emacs for each of the Prime computers they purchased for GIS. Our experience managing these systems for the BLM has shown that programmers tend to love Emacs because of it's power and flexibility. However, programmers are the only users who love it. Other users dislike the cryptic command interface which requires users to memorize control character sequences for the commands. To fix this problem we wrote software in Prime's Emacs Extension Language (PEEL) to bind Emacs functions to terminal function keys. Then we built templates using AutoCad for the terminal keyboards. This was a major success. It made Emacs much friendlier and easier to use.

Considering our success with Emacs we thought a system of this sort might work well with MOSS/MAPS. Such a system would have several strengths including:

- Reducing the amount of typing required by users
- Reducing the need to memorize complex MOSS/MAPS syntax
- Preserving the original MOSS/MAPS feel and thus preserving MOSS user's training experience
- Operating system independence

Moreover, the system would be simple to install and use, and would require no modifications to the MOSS software.

David Mandel and Kieu Suong Nguyen tried to build a prototype system using key board templates. They encountered several difficulties:

- Some of the most tedious typing in MOSS/MAPS requires the input of coded maps names and map attribute labels. It is difficult to write software to load these into function keys and once the function keys are loaded users don't know which key contains which name.
- Terminals vary a great deal as to their download ability. Many terminals are non down loadable or have insufficient memory to hold all the information MOSS/MAPS requires.
- MOSS/MAPS requires lots of information and terminals simply don't have enough function keys to make a system like this usable.

Moreover, as one loads more and more information into the function the keyboard templates become overly complex.

For the reasons above this project was dropped.

5. Implement Prime's Command Line Editor in MOSS/MAPS

Prime gives users a very powerful editor for recalling and editing command lines. This editor is called ECL. It works on a 200 line circular stack of commands called the history buffer. ECL allows users to save and restore these history buffers. ECL allows users to do reverse or forward search for a command and then change the command using Emacs like edit functions before submitting it to Primos for execution.

Generally Prime computer users can only use ECL at the operating system command level. Once they are in a program ECL is replaced by what ever editing system the program has built into it. In the case of MOSS/MAPS the user can use the backspace key and the kill key and nothing else. However, a few Primos utility programs like FTP enable Prime's ECL for usage within the utility. Enabling ECL for usage within MOSS/MAPS would have many benefits including:

- Reduction in need for user typing
- It would preserve the original MOSS/MAPS feel and users current training and experience would still apply
- It would give MOSS/MAPS a more Primos like feel
- Implementing ECL would require changes to MOSS, but all changes would be upwards compatible, so shell programs would continue to function.

Finally, ECL in MOSS/MAPS wouldn't be very difficult to implement. Lines in MOSS/MAPS requesting input from the user look something like:

```
      CALL TNOUA(PROMPT, INTS(11))
      READ(*,110) COMMAND,I,J,K,X,Y,Z
  110 FORMAT(A25,3I10,3F10.2)
```

TNOUA is a Primos subroutine which writes a specified number of ascii characters from a string, PROMPT, directly to the user's terminal without writing a carriage return or line feed. To introduce ECL to MOSS/MAPS one adds a new variable to each subroutine requesting user input using the line:

```
      CHARACTER DATLIN*256
```

Next, one simply replaces the above sequence of lines with the sequence:

```
      CALL RD_ECL(PROMPT,11,DATLIN,NDATLIN,1,CODE)
      READ(DATLIN,110) COMMAND,I,J,K,X,Y,Z
  110 FORMAT(A25,3I10,3F10.2)
```

and then one adds a new subroutine called RD_ECL to MOSS/MAPS. This new subroutine is responsible for printing the prompt to the user's terminal, and for reading the user's reply. To read the user's reply RD_ECL will use internal Primos commands to enable ECL. However, it could do anything. For example, it could map lower case characters to upper case. All that is really required is that in the end RD_ECL pass a string, DATLIN, back to the calling program which looks like what MOSS user would have normally enter manually.

David Mandel wrote a memo describing this way of implementing ECL for MOSS/MAPS in Dec 1989. We have included this memo as an appendix to this paper for those wanting a more detailed description. The Denver Service Center and Autometric Inc. have use this to implement ECL in the up coming release of MOSS/MAPS.

Introducing ECL to MOSS/MAPS is an important advance which will help many MOSS/MAPS users a great deal. However, it does have draw backs

including:

- It requires changes to the MOSS source code.
- ECL is only available under Primos.
  In theory one could make the RD_ECL routine elaborate enough so that one didn't need to call Primos ECL subroutines, but this would increase the amount of code required by a great deal.
- While ECL does improve MOSS/MAPS's user friendliness a great deal, it also leaves many problems unresolved.

6. EZMOSS

None of the systems we have discussed so far give us the flexibility that a quality user interface should have. One should be able to point to commands and macros, and one should be able to customize the commands available to the user and the formats of reports a user receives. Moreover, this should be easy enough that a sophisticated user can do a good deal of this for him or her self without the aid of professional programmers. To do this the user interface should incorporate an extremely powerful editor like Emacs.

Since we don't have the resources to write a major editor from scratch, we started looking for ways of putting something in front of MOSS/MAPS. To do this we would need to use a PC instead of a dumb terminal, but PCs are readily available now days so this isn't a problem. However, we couldn't find a terminal emulator with the flexibility and power we needed.

Finally MicroSoft came out with MS Windows 3.0. This promised true multi tasking under DOS on 80386 based machines and the ability to cut and paste between different windows. In fact, Windows supports a type of automatic cutting and pasting called dynamic data exchange (DDE). In theory this makes it possible to run a MOSS command generator in one window, and a graphical terminal emulator in another window, and move data between the two tasks as needed.

Implementing a system of this type would be involved, but the benefits would be enormous. MOSS/MAPS users would get:

- Reduced typing. In many cases they could simply point at the commands they desired. Then a list of acceptable arguments would appear on the screen and the user could point at one of these.
- Ease of use.
- Pleasant point and shoot feel. One could make this feel very much like LTPlus.
- Better integration between MOSS and MAPS and very possibly between MOSS/MAPS and other mini based applications.
- Integration between micro applications and MOSS/MAPS.
- Flexibility. Under this system valid MOSS commands and arguments would come from user definable menus. Commands could even be macros.
- A full macro language based on Lisp or C.

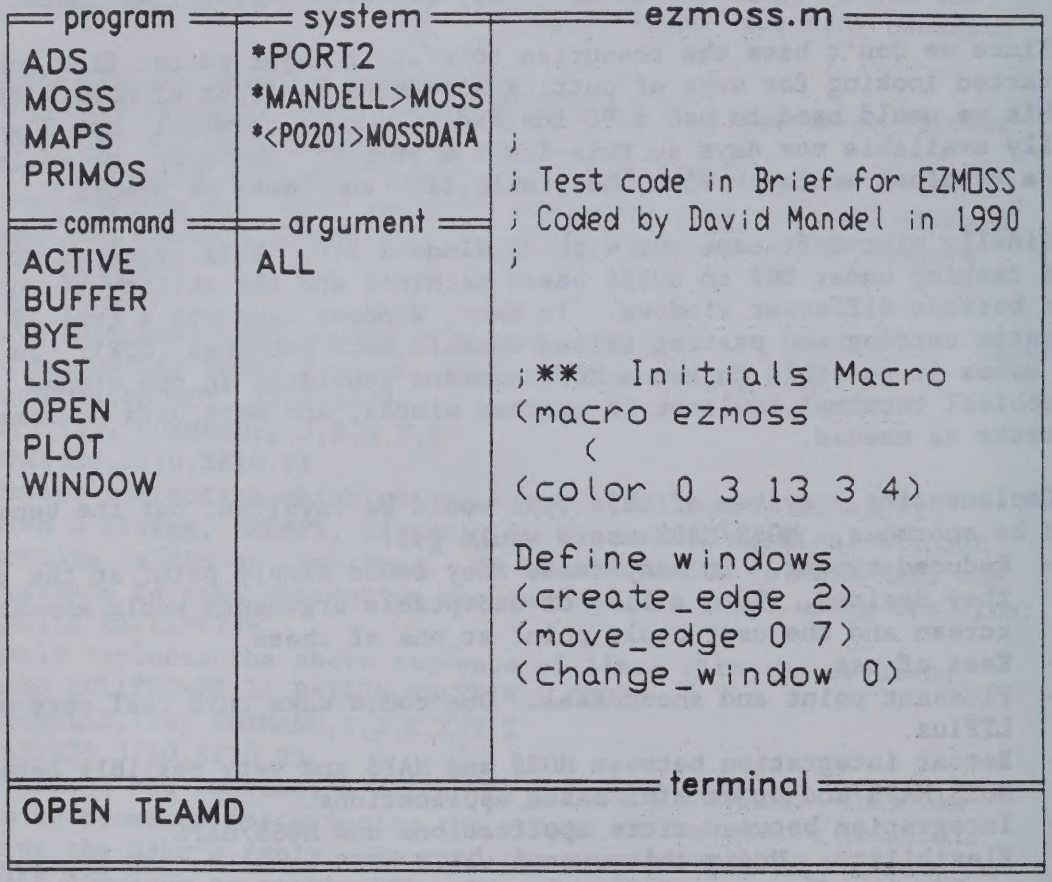
For this reason the authors studied this approach in great detail. For our prototypes we used a Compaq 386 with 6 mb RAM and a 40 mb hard disk. For software we used:

- MS Window 3.0
- Brief
  This is a very powerful Emacs like editor by UnderWare Inc. We selected it because it has a very complete macro language which understands both C and Lisp syntax. It also has key capture and play back functions. Finally, it has excellent windowing support making it easy to build point and shoot menu programs. Unfortunately, it lacks mouse support and it is a non MS Windows program.

- Emu-tek
  This is a quality terminal emulator which emulates a Tektronix 4107 complete with color and segment support. It is also a non MS Windows application.

Using these tools we were able to run Brief and Emu-tek at the same time under Windows. We did have problems with dropped characters and messed up graphics using Emu-tek. This is typical with serial communications under Windows. After fine tuning priorities and buffer sizes we were able to reduce the number of communications errors, but we were not able to eliminate them completely.

Using Brief we were able to produce a menu system with nice looking screens which worked much like LTPlus. We only built a prototype, so the menu system was very incomplete and it would require a substantial programming effort to complete. However, there are no major theoretical problems to completing this menu system and the completed system would perform extremely well.



Using the cut and paste features of Windows we were able to move MOSS command sequences from the Brief window to the Emu-tek window. We were also able to move audit tables and other MOSS reports from Emu-tek to Brief. These moves were done manually and didn't work quite as easily as we had hoped, but they did work. In fact, we were able to move report information into Word Perfect and we could move MOSS graphics from Emu-tek to Window's draw utility. We could easily extend these techniques to move information from DBase to the Brief window where Brief macros use this information to build MOSS command sequences. With a bit more work we could even take the Emu-tek graphics into various CAD systems such as AutoCad.

Unfortunately, there are still a number of theoretical problems preventing the complete implementation of EZMOSS as discussed above. We still don't have completely error free communications between Emu-tek and the Prime

mini computers when we run Emu-tek under Windows. Moreover, Emu-tek does not support sophisticated file transfer protocols between the Prime mini computers and the PC.

Also, moving data between the Brief and Emu-tek windows should be automatic, but automating this would require the use of Window's DDE features. Unfortunately, DDE is only available for application programs written specifically for MS Windows and only some of these programs support DDE at this stage. Neither Brief nor Emu-tek are MS Windows programs and neither company has immediate plans to add this enhancement to their software. Many software vendors are currently developing Windows applications and there aren't many on the market yet. Thus, we have not been able to find acceptable replacements for either Brief or Emu-tek at this point.

From our efforts to build a prototype of EZMOSS we have drawn several conclusions. A system of this sort is very feasible and would revolutionize MOSS/MAPS for most users. It does require users to use 80386 based PCs instead of terminals. These PCs are more expensive than terminals, but the cost of 80386 based PCs is dropping and most businesses have already stopped purchasing new PCs in the 8088 and 80286 category. There are still a few serious problems which would hamper building the EZMOSS system. However, many new Windows applications are appearing on the market and we believe these new applications will allow us to solve these problems easily.

7. Other Systems

It is possible that the MS Windows market may mature slower than we expect. If this would happen there may still be a number of ways of implementing EZMOSS. We haven't given detailed consideration to any of these, but we have considered several of these alternative solutions briefly.

7.1 X-EZMOSS

In many ways MS Windows was meant to be MS DOS's answer to Unix's X-Windows. Of course, X-Windows is much more powerful and flexible, so one might be able to implement something like EZMOSS in the Unix X-Windows environment. The easiest way of doing this would be to depend heavily on off the shelve products. This would require Unix versions of Emu-tek and Brief or suitable substitutes. An alternative to this might be to run Emu-tek and Brief in a DOS emulator running under Unix.

We have looked into a number of these options. In our case we used a Compaq 386 running SCO Open Desk Top as our Unix workstation. We have found that there is no Unix version of Emu-tek and to date we haven't found a suitable substitute for Emu-tek. Moreover, we have not been able to use the DOS version of Emu-tek very effectively in this setting. On the other hand, there seems to be lots of workable options for the editor. Several different vendors produce good versions of Emacs for Unix or one could continue to use the DOS version of Brief. Any of these seem to work quite well.

From a technical point of view a very nice workable Unix/X Window solution could be implemented. However, even low end Unix workstations based on PC technology are expensive (and powerful). Using a machine of this sort as a terminal is total overkill.

7.2 The MOSS Shell System

Since we have Emacs on our Prime mini computers and the Primes support MOSS, we have considered many ways of building EZMOSS entirely on the Primes.

Unfortunately, this is not simple and there are many difficult problems that must be solved. For example, Emacs will not pass control characters to the users terminal. This means that one can not pass graphs to the terminal while one is in Emacs. This also makes it impossible to use Emacs to down load terminal function keys. As a result it is impractical to invoke a Emacs program which in turn invokes MOSS. We have also considered using using the SYSTEM command in MOSS to invoke Emacs, but this leads to similar problems.

As an alternative to this we have considered running two lines from the mini computer to the user terminal. Under this system the user would log into the Prime using one of the lines and invoke an Emacs based menu program. This program would look very much like the menu program for EZMOSS, only it would write the MOSS command lines into a file on the Prime called MOSS_CMD. The other line to the terminal would be running MOSS. However, MOSS would be modified by adding subroutines called RD_ECL and WR_ECL. In this case RD_ECL would be a specially designed program designed to get it's input from the file MOSS_CMD instead of the terminal keyboard. In fact, the only direct terminal input to MOSS would be the reading of a graphics cursor. This is required when the user uses MOSS commands like ZOOM, DISTANCE, and LOCATE.

The Emacs based command generator would require the same level of programming effort as the Brief based command generator discussed in the EZMOSS section of this paper. The required changes in MOSS would be relatively minor to make. The developers would have to be careful in building the communications between the command generator process and the MOSS process. The communications system needs to have handshaking built into it to make sure the MOSS process doesn't read commands before the command generator has finished issuing them and vice versa. Also, processes have to have a way of communicating unexpected events such as MOSS blowing up for some reason. The authors have built systems of this type in the past and feel these problems could be handled.

This solution has potential. However, it requires terminal which function well with dual ports. Only a few terminals do this and very few terminal emulators do this. Few building have sufficient wiring to have two lines to each terminal. More importantly this solution isn't philosophically pleasing. It is too make shift. For all of these reasons we have shelved this solution method.

7.2 RD_ECL/Emacs

While we may never want to implement The MOSS Shell System as described above, it has given us new ideas. When we originally conceived the MOSS Shell System it required three simultaneous processes to run it. Since that time we have cut this back to two. A step beyond this might be to cut this back to one by rewriting RD_ECL. The idea here is that instead of having RD_ECL make system calls to ECL functions it could invoke the Primos subroutine CP$ to make a call to a MOSS command generator built around Emacs. An alternative to this would be to make RD_ECL itself complex enough that one wouldn't need to call Emacs or any similar utility.

8.0 Conclusion

We have outlined several methods of improving the MOSS/MAPS user interface. A couple of the methods are fairly easy and would make modest improvements in user friendliness. We consider the addition of ECL to be this type of an improvement. Some of the other methods proposed would be

complex to implement and even present some unresolved theoretical problems. However, all of these problems are very solvable and it is technically possible to create a EZMOSS like interface for MOSS/MAPS which would totally and completely revolutionize the way user's interact with MOSS. In deed, the revolution would be so great that people would start using MOSS in ways we only dream about today.

This leads to the final problem. MOSS has many serious efficiency problems. MOSS also lacks several basic features required for it to be a true GIS. For example, MOSS does not support a complete bollean algebra. Worse yet, MOSS has serious numerical errors. These problems have been part of MOSS for many years and we fear they will continue to exist as long as MOSS exists. These problems present MOSS users with many headaches today. A good user interface like EZMOSS would put a greater burden on MOSS and in it's current condition MOSS simply wouldn't function well enough to support the user interface.

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Appendix A.

Enabling ECL Usage in MOSS
(One easy step to improve the MOSS user interface)

by David Mandel

Introduction

When using MOSS and MAPS one often types in command sequences like:

```
FREE ALL
SELECT S30W05FOI ALL
SELECT S30W06FOI ALL
SELECT S30W07FOI ALL
SELECT S30W08FOI ALL
WINDOW 1 2 3 4
PL 1 2 3 4
FREE ALL
SELECT S30W05TPC ALL
SELECT S30W06TPC ALL
SELECT S30W07TPC ALL
SELECT S30W08TPC ALL
WINDOW 1 2 3 4
PL 1 2 3 4
AUDIT S30W05TPC
AUDIT S30W07TPC
ETC.
```

Usually the SELECTs are a bit more specific than ALL and often the commands are more complex involving BUFFERs and INTERSECTs, but the favor is the same. The user ends up typing similar commands time after time after time and some of the map names are difficult to type correctly. This is especially true if the user's keyboard skills aren't very good.

Proposed Enhancement to MOSS and MAPS

Prime has given us a very powerful solution to this problem at REV22.0. Starting at this revision it is very easy for programmers to enable Prime's command line editor for input to their own programs. Moreover, it is fairly easy to upgrade existing programs to incorporate this new feature.

To incorporate this enhancement into MOSS and MAPS one would have to write a subroutine like RD_ECL which we have included at the end of this article. Next, one must go into each subroutine in MOSS and MAPS with the editor and search for READ statements which read from the command input stream (as opposed to reading from a data file). A typical statement might look like:

```
      TNOUA(PROMPT,INTS(11))    /* Where PROMPT is CHAR*32
      READ(*,110) COMMAND, I, J, K, X, Y, Z
  110 FORMAT(A25,3I10,3F10.2)
```

One could enable the command line editor by inserting the data specification statement:

```
      CHARACTER DATLIN*256  /* The 256 could be much smaller if desired.
```

and changing the three statements to:

```
C      TNOUA(PROMPT,INTS(11))    /* This statement is no longer required.
      CALL RD_ECL(PROMPT,11,DATLIN,NDATLIN,1,ICODE)
C     Read from internal file rather than directly from terminal.
```

```
      READ(DATLIN,110) COMMAND, I, J, K, X, Y, Z
  110 FORMAT(A25,3I10,3F10.2)
```

Notice the required change is very simple. Even through there may be hundreds of these changes to make in a hundred different subroutines, it should be fast and easy to make all the required changes. Once all the changes are made one simply recompiles all the subroutines again and links them together with BIND. As well as loading all the MOSS and MAPS subroutines one must load RD_ECL toward the end of the load sequence and finally one must use the

```
LI ECL$LIB
```

subcommand to give RD_ECL access to the ECL$CL system's subroutine.

There is one small problem with the above enhancement as shown. The second to the last argument in RD_ECL is set to 1. Setting this to 1 changes all input to upper case before returning it to the program. This would certainly improve MOSS. However, some states may use lower case MOSS subjects and descriptive headers which should not be translated. Thus, ideally this argument should be user configurable and the default should be 0. However, it should be easy to add a new command to MOSS called CASE which would do nothing other than setting the value of ICASE in a common block which could be accessed to pass the proper value of ICASE to RD_ECL. Better yet, one might prefer to simply modify RD_ECL so that it would access the common block containing ICODE. Then ICODE should be removed for RD_ECLs argument list.

Conclusion

The above change is fairly easy and inexpensive to make. By allowing users to recall previous commands and edit them, ECL would relief users and a great deal of redundant typing and give them a record of their last 200 commands to act as a MOSS memory aid. In addition, RD_ECL could be used to allow users to type MOSS commands in either lower or upper case. This is a small band aid and it is not the revolutionary change the MOSS/MAPS user interface really needs. However, this is a start. The enhancement is very cost effective in that users benefit greatly relative to the cost of the enhancement. Moreover, the enhancement is totally upwards compatible with everyone's existing CPLs. This change would benefit all Primos based MOSS users across the nation.

SAMPLE PROGRAM

```
      PROGRAM TEST_ECL
      CHARACTER PROMPT*256, DATLIN*256
      PROMPT = 'Enter Data: '
      NPROMPT = 12
      CALL RD_ECL(PROMPT,NPROMPT,DATLIN,NDATLIN,1,ICODE)
      WRITE(*,'(2A)') 'Output = ', DATLIN(1:NDATLIN)
      STOP
      END

      SUBROUTINE RD_ECL(PROMPT,NPROMPT,DATLIN,NDATLIN,ICASE,ICODE)
C
C     WRITTEN BY DAVID MANDEL
C                INFOTEC DATA PRODUCTS
C                LLOYD 500 BUILDING
C                PORTLAND, OREGON 97232
C     WRITTEN FOR THE PORTLAND BUREAU OF LAND MANAGEMENT
C     FOR INFORMATION CALL DAVID MANDEL AT (503) 230-5903
C
C     THIS SUBROUTINE IS FOR DOING READ COMMANDS FROM F77 USING PRIME'S
C     COMMAND LINE EDITOR.  IT ALSO HAS AN OPTION TO FORCE OUTPUT TO UPPER
C     CASE REGARDLESS OF WHAT CASE IS ENTERED.
C
```

```
C     ARGUMENTS
C         PROMPT - CHAR INPUT UP TO 32 CHARACTERS LONG.
C         NPROMPT- INTEGER*4 OUTPUT
C                  USABLE LENGTH OF PROMPT (DO NOT INCLUDE TRAILING BLANKS)
C         DATLIN - CHAR OUTPUT (SHOULD BE CHAR*256)
C                  THIS CONTAINS THE INPUT LINE THE USER ENTERED.
C         NDATLIN- INTEGER*4 OUTPUT
C                  USABLE LENGTH OF DATLIN (DOES NOT INCLUDE TRAILING BLANKS)
C         ICASE -  INTEGER*4 INPUT
C                - 0 IF DATLIN IS TO BE RETURNED WITHOUT CHANGING CASE.
C                - 1 IF DATLIN IS TO BE RETURNED IN ALL UPPER CASE.
C         ICODE -  INTEGER*4 OUTPUT
C                - 0 IF NO ERRORS OCCURRED
C                - 1 IF SOMETHING WENT WRONG
C
C     CAUTION:  PRIMOS DEPENDENT ROUTINE.
C               THIS ROUTINE USES PRIMOS SUBROUTINES ONLY AVAILABLE AFTER
C               REV 22.0 OF PRIME PRIMOS.
C
C     CAUTION:  NON ANSI FORTRAN
C               THIS ROUTINE USES COMMON FORTRAN EXTENSIONS SUCH AS NON
C               STANDARD VARIABLE NAMES.  IT SHOULD COMPILE ON MOST COMMON
C               1977 COMPILERS, BUT NOT ALL OF THEM.
C
      CHARACTER PROMPT*32, COMMLIN*256, DATLIN*(*)
      INTEGER*2 ICOMMLIN(41), ICOMM, ICODE
      EQUIVALENCE (ICOMMLIN(2),COMMLIN)
C
C     INITILIZE VARIRABLES, CREATE PL1 VARIABLES, ETC.
      ICODE = 0
      COMMLIN = PROMPT
      ICOMMLIN(1) = NPROMPT
      IF( NPROMPT .GT. 32) THEN
          ICODE = 1
          WRITE(*,'(A)')
     1'ERROR!!  The PROMPT passed to the subroutine RD_ECL is .GT32'
          RETURN
          END IF
      ICOMM = 256
C
C     GET INPUT USING COMMAND LINE EDITOR.
      CALL TNOUA(COMMLIN,ICOMMLIN(1))
      CALL ECL$CL(ICOMMLIN,ICOMM,ICODE)
C
C     FILL THE NORMAL F77 VARIABLES WITH VALUES TO RETURN.
      IF( LEN(DATLIN) .LT. ICOMM) THEN
          ICODE = 1
          WRITE (*,'(A)')
     1'ERROR!!  The DATLIN passed to the subroutine RD_ECL was not',
     2'large enough to hold the complete command line.'
          RETURN
          END IF
      DATLIN = COMMLIN
      NDATLIN = ICOMMLIN(1)
C
C     CHANGE COMMAND LINE TO ALL UPPER CASE BEFORE RETURNING IF REQUESTED.
      IF( ICASE .EQ. 1) THEN
          DO 50 I=1,NDATLIN
              IASC = ICHAR(DATLIN(I:I))
              IF((IASC .GE. :341) .AND. (IASC .LE. :372)) THEN
```

```
                IASC = IASC - :40
                DATLIN(I:I) = CHAR(IASC)
                END IF
   50         CONTINUE
           END IF
C
C     THE END
      RETURN
      END
```

Documentation from the Service Center: A New Approach

MOSS User's Convention
Portland, Oregon November 26-30 1990

Presented by:

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Lakewood, Colorado 80225-0047

The Macintosh Way

To do what is right, the right way,

and believe that everything else will fall into place.

- Guy Kawasaki -

This is not just a catchy slogan.

It is a way of thinking; a way of doing a job.

When you understand the technology at your disposal, and its infinite possibilities, then you are on the path to innovation, creativity and productivity.

Documentation from the Service Center: A New Approach

MOSS User's Convention
Portland, Oregon November 26-30 1990

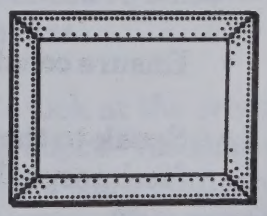
This is a very exciting period of time for all of us involved with the development of User Documentation at the Service Center. New and more versatile technologies have been introduced which enable us to create more professional and functional documentation. This capability, represented by the Macintosh II family of computers, and State of the Art publishing software, means that users will receive outstanding products which will greatly enhance their ability to utilize software supported by the Bureau of Land Management.

1. What is the Field Support documentation task at the Service Center?

The Field Support Section maintains and develops various training manuals, user manuals, help files, reports, papers, and other documents. This involves: documentation planning, management, editing, desktop publishing, copying, distribution, filing, protection, amending or appending, writing and documentation control.

2. That sounds like an easy job.

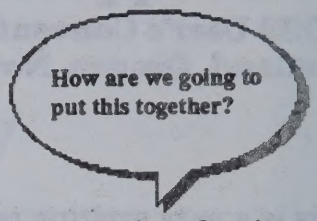
The job of documentation is not as easy as it sounds. Teamwork at all levels of a software or system development project is required to produce quality documentation. The people involved with desktop publishing and graphics development are not always experts in the system they are documenting; just as the people who are involved with programming and system development are often far-removed from the impact their work has on the documentation process. Technical writers exist somewhere in between, and are responsible for creating an exact representation of the system they are assigned to document.



The Big Picture:
Understanding the process

The goal is to efficiently coordinate the efforts of everyone involved. When this does not happen, the result can be the publishing of a document that does not reflect the real-world functionality of the system documented.

3. What have we done at the Service Center in order to ensure that the documentation task gets done right the first time?



Asking The Right Questions: *Planning and teamwork prevents confusion and frustration*

We started by getting everyone involved. In the case of the new MOSS and ADS documents, personnel worked interactively at all levels. The documents themselves were revised and edited by the people who possess expert system knowledge, field Hotline Calls, and solve user problems (Barb Duggan, ADS & Steve Raber, MOSS). Both Barb and Steve worked closely with system development personnel to ensure that discrepancies were resolved and changes were reflected accurately. As a result, I was supplied with a solid body of data which was molded into what we think will be the best user documentation the Service Center has produced on the two subjects.

4. What is our attitude/policy regarding User Documentation?

We are dedicated to developing functional products that satisfy the needs of the user community. User Documentation is useless unless it helps people understand and utilize computer software. So we look beyond the system design, to create documentation that serves the actual user.

5. How do we accomplish this goal?

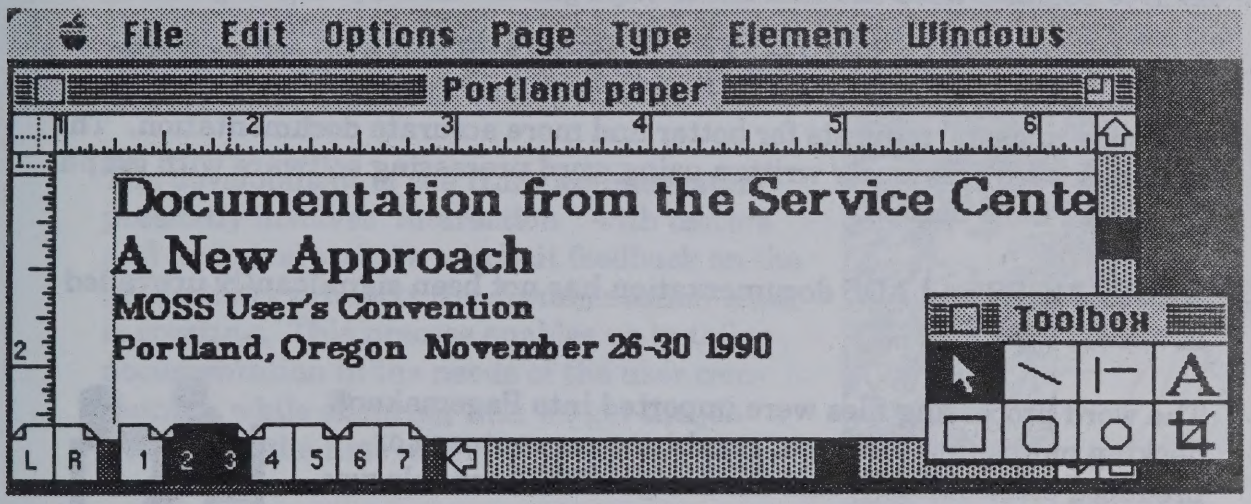
We have introduced a documentation process which features the following major elements:

Technical Writing - A job that is much more than correcting typos and spelling. An experienced writer can make the process of explaining systems to users relatively painless and efficient. More than simply speeding things up, however, a good technical writer can:

- Ensure consistency throughout a documentation project
- Speak to the user in an understandable language free from "technospeak"
- Translate the knowledge of subject matter experts to the end user
- Relieve programmers from the documentation task
- Organize materials and write step-by-step instructions in a concise way that *users* can understand

Desktop Publishing - The newest piece of the documentation team effort concept. Using advanced technology and the latest publishing software, full length documents can be produced that are:

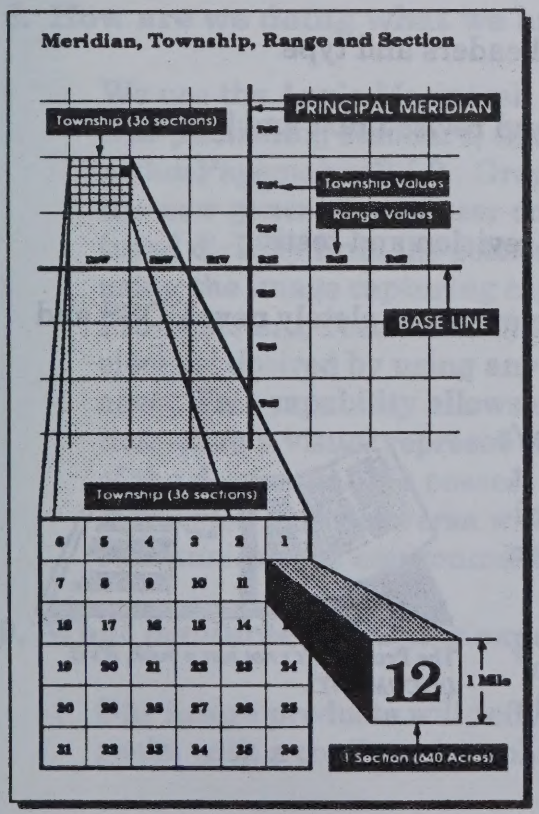
- completely electronic, including graphics



The Environment: *Apple Operating System running Aldus Pagemaker® 4.0*

- extremely efficient and inexpensive to produce as well as easy and fast to maintain and update

- translatable to a myriad of computing environments, especially to files usable for on-line documentation



Graphics Development - This creative and artistic addition to the documentation process allows us to create graphics that are:

- customized and designed to enhance ideas presented in the text

- easy to make and cost-effective since graphics costs are in-house

A Team Approach - We look at the creation of a document as a group effort. We share responsibility and recognize the significance of each individual in the process. This approach encourages innovation, creativity, and cooperation and ensures that we create the best product possible.

Custom Graphics: *This graphic was designed to convey a concept presented in the text. It was created in MacDraw II 1.1® and incorporated into a Pagemaker® 4.0 document.*

User Involvement - We actively solicit feedback from the user community on the products we make. This process ensures that what we publish will be as functional and accurate as possible.

6. What are we doing right now?

In conjunction with a revision of the MOSS/MAPS and ADS software, the Bureau of Land Management directed a revision of the User's Manuals in response to users' requests for better and more accurate documentation. The manuals were previously written using word processing software with graphics pasted in as needed.

NOTE: MOSS and ADS documentation has not been significantly upgraded in almost a decade.

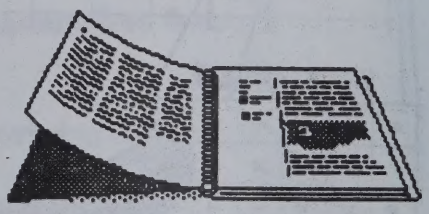
The word processing files were imported into Pagemaker® desktop publishing software, graphics were captured or produced electronically, and the design of the manuals was completely reworked.

Using the Technology: *Putting ideas in motion and doing things the right way the first time.*

The republished versions of the documents, produced at a minimum of expense and time, now have the benefit of being:

- quickly maintainable because they are in almost totally electronic form
- easier to use and read with new page headers and type
- less complicated due to newly edited and revised text and better examples
- more accurate as a result of technical revision and testing
- much more convenient with the inclusion of completely new MOSS and MAPS Quick Reference Guides.

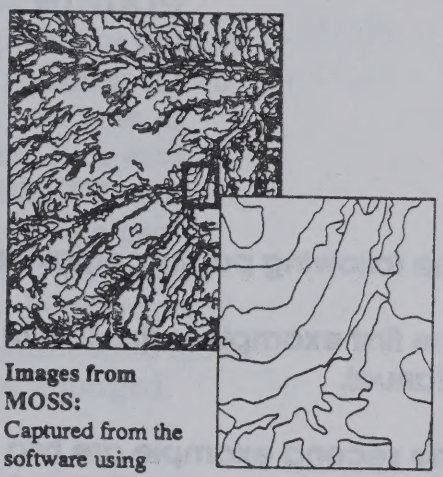
The republishing of the MOSS and ADS User's Manuals involves analyzing the software as it exists and ensuring that what the user experiences at his terminal is reflected accurately in the document. We ensure that on-line help files mirror the hardcopy documentation by uploading the text from the electronic copy of the document directly to the appropriate help



The Product: *It's not just a book, It's a DOCUMENT!*

file location. This process makes for efficient and low-cost revision to the entire document. This new generation of documentation will be characterized by a fresh new look on every page available through the introduction of advanced publishing techniques. These documents are more readable and pleasing to the eye. The writing style of the text has been changed to make the documents more personal (a user is referred to as "you" rather than the traditional "the user"), and ideas are expressed more completely to accommodate all user proficiency levels.

The development of the ILIS documentation presently involves interaction with testers and technical writers to solicit feedback on the preliminary products the documentation team is creating. This process enables us to tailor documentation to the needs of the user community, while ensuring that we get the job done right the first time.

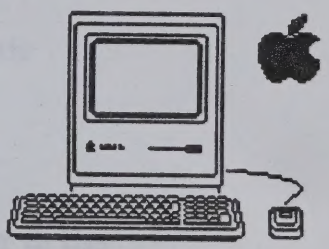


Images from MOSS: Captured from the software using Versaterm Pro®

7. Why are we doing what we are doing?

We are doing all of this because it is our goal to improve the quality and functionality of both existing and future BLM documentation. We want to create documentation that reflects state of the art appearance and style, and allows users to do their job more effectively.

8. How are we doing what we are doing?



We use the Apple Macintosh II family of computers. Our publishing standard, the same as the BLM's, is Aldus Pagemaker® 4.0. Graphics images contained in the new generation of user documentation are captured directly from the software (when applicable) using the image capturing capabilities of Studio/8® graphics and Versaterm Pro Tektronix Terminal Emulation software. We can construct any graphic element desired by using any one of a number of graphics development packages. This capability allows us to customize graphics within the documentation when a visual representation would clarify an idea expressed in the text of the document. We possess the capability to convert text from MS-DOS to Macintosh and vice versa which allows us to interact with virtually any data communications environment to support our documentation task.

9. What products can users expect in the future?

Our future products will reflect the further development of the above stated goals, with a continued emphasis on feedback from the user community.

The following pages contain examples of our efforts.

The first example is the ZOOM command from the upcoming MOSS User's Manual.

The second example are two release announcements for our upcoming documentation.

The third is a document (Planning Aid 7) we created for the Washington, D.C. office.

ZOOM (ZO)

The **ZOOM** command is summarized as follows:

> **ZOOM** is a data display command that allows you to magnify a portion of the display window specified by the **WINDOW** command. You should display a map on the screen for orientation. The area to be magnified is indicated by pointing to two diagonal corners of a rectangle that bound the new area of interest. Pointing is accomplished with the cross hair cursor. The effect of **ZOOM** can be reversed with the **RESET** command. If the GEOG option is used, you may type in a geographic coordinate pair (x and y location) and set the display window with the coordinate pair as the center. In addition, if the POINT option is used, you may set the magnification factor and locate a point at the center of the area to be enlarged.

The **ZOOM** command is specified as follows:
(* denotes parameters that can only be entered after a prompt)

> **ZOOM (cross hair input)***
>
> **ZOOM (GEOG) (latitude)* (longitude)* (window size)***
>
> **ZOOM (POINT) (magnification factor)* (cross hair input)***

The parameters of the **ZOOM** command are described below:

> **(cross hair input)** allows you to point with the cursor to the opposite diagonal corners of the new viewing rectangle. This option is not used if the GEOG option is specified.
>
> **(GEOG)** is an option that prompts you to type in a geographic coordinate pair, which is the center of a viewing window, also set by you. This option must be entered on the command line.
>
> **(latitude)** and **(longitude)** are the coordinate pair of the center of the window. Each will be prompted for separately and should be entered in degrees, minutes, and seconds.

NOTE: For Western Hemisphere, place a - (negative) sign in front of longitudinal values.

Zoom Continued...

(window size) is the height and width of the window entered in seconds of latitude and longitude.

(POINT) is an option that prompts you for a magnification factor and prompts you to point to the center of the area to be magnified. This option must be entered on the command line.

NOTE: Use space bar to mark the point after cross hairs are at the correct position.

(magnification factor) indicates the change in scale. For example, if 2 is entered and the map is replotted, the items (features) on the resulting map will be shown twice as large.

The following are examples of the **ZOOM** command:

```
ENTER COMMAND?
ZOOM
POINT TO CORNERS OF NEW DISPLAY WINDOW  or...

ENTER COMMAND?
ZOOM GEOG
ENTER LATITUDE TO ZOOM ON
: 39 56 8
ENTER LONGITUDE TO ZOOM ON
: -108 24 43
ENTER SECONDS OF LONGITUDE AND LATITUDE FOR WINDOW
: 180 180 or...

ENTER COMMAND?
ZOOM POINT
Please enter MAGNIFICATION factor
: 2
Please point to ZOOM center
```

The limitations of the **ZOOM** command are as follows:

- Cannot zoom to infinity (i.e., a point needs to be specified).
- Cannot point outside of the viewing window (i.e., cannot use **ZOOM** to enlarge the viewing window) except when using the POINT option.
- The screen must be erased and maps replotted after using the **ZOOM** command.

Zoom Continued...

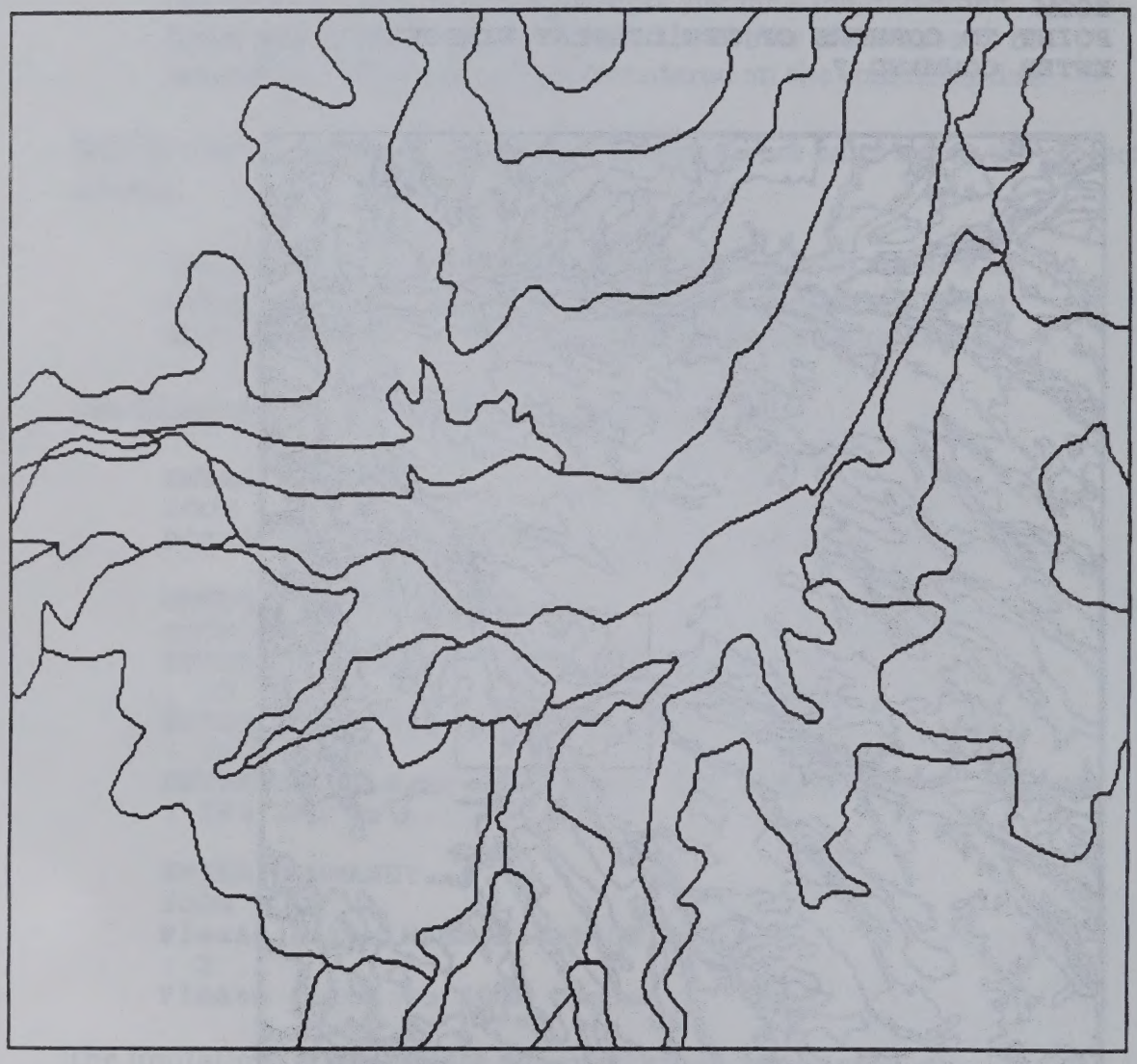
Example of output using the ZOOM command:

```
ENTER COMMAND ?
ZOOM
POINT TO CORNERS OF NEW DISPLAY WINDOW
ENTER COMMAND ?
```

The map of interest is of surface cover types on Wolf Ridge, CO. The area of interest is indicated by cross hair input, defined by the corners of a rectangle and subsequently enlarged, as shown on the following page.

Zoom Continued...

Example of output using the **ZOOM** command:

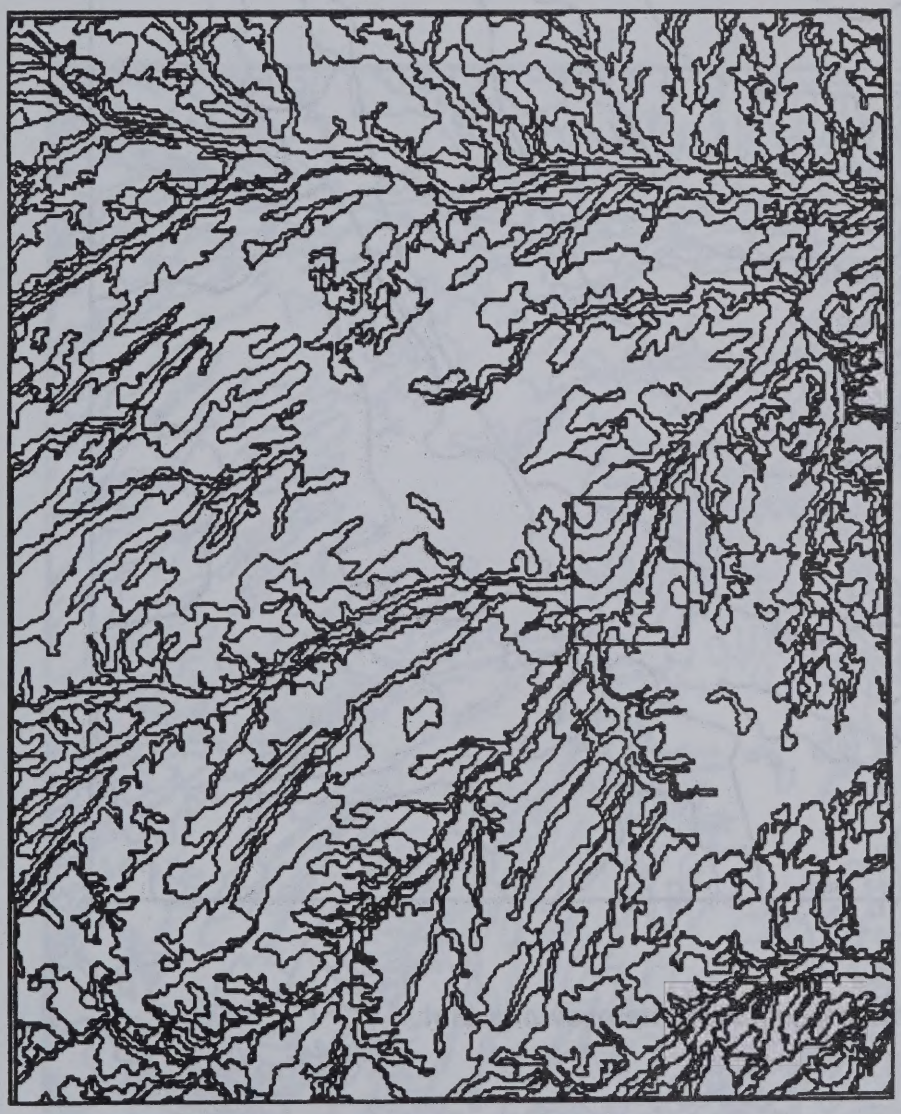


Resolution is increased over previous plot.

Zoom Continued...

Example of output using the GEOG option of the **ZOOM** command:

```
ENTER COMMAND ?
ZOOM GEOG
ENTER LATATITUDE TO ZOOM ON
: 39 58 8
ENTER LONGITUDE TO ZOOM ON
: 108 24 43
ENTER SECONDS OF LATITUDE AND LONGITUDE FOR WINDOW
: 60 68
```

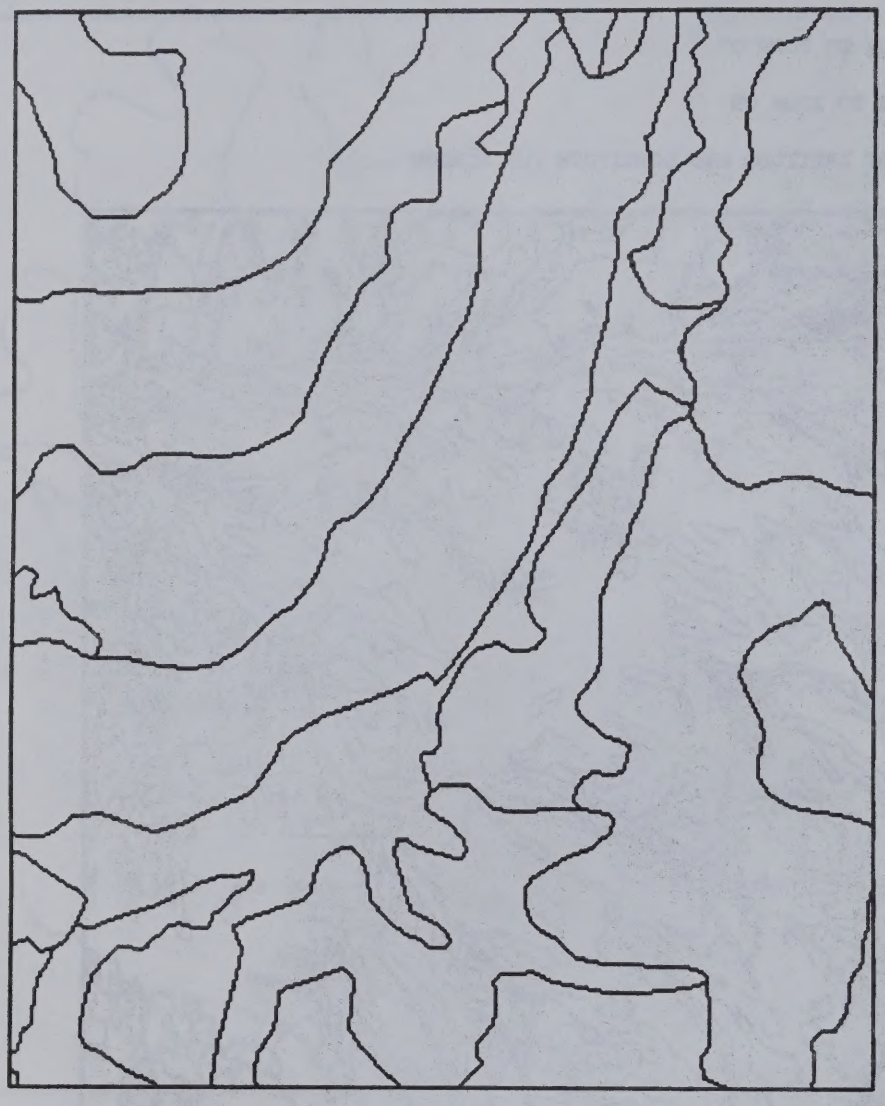


The map of interest is of surface cover types on Wolf Ridge, CO. A coordinate pair for the center of the area to be enlarged can be obtained by using **LOCATE GEOG**. The area of interest is indicated by the boxed area on the map.

NOTE: The size of enlargement is entered in seconds of longitude and latitude.

Zoom Continued...

Example of output using the GEOG option of the **ZOOM** command:



Resolution is increased over the previous plot.

Zoom Continued...

Example of output using the POINT option of the **ZOOM** command:

```
ENTER COMMAND ?
ZOOM POINT
Please enter MAGNIFICATION FACTOR
: 5
Please point to ZOOM center

ENTER COMMAND ?
```

The map of interest is of surface cover types on Wolf Ridge, CO. The cross hairs are simply centered on the area to be enlarged by the amount of magnification specified.

Zoom Continued...

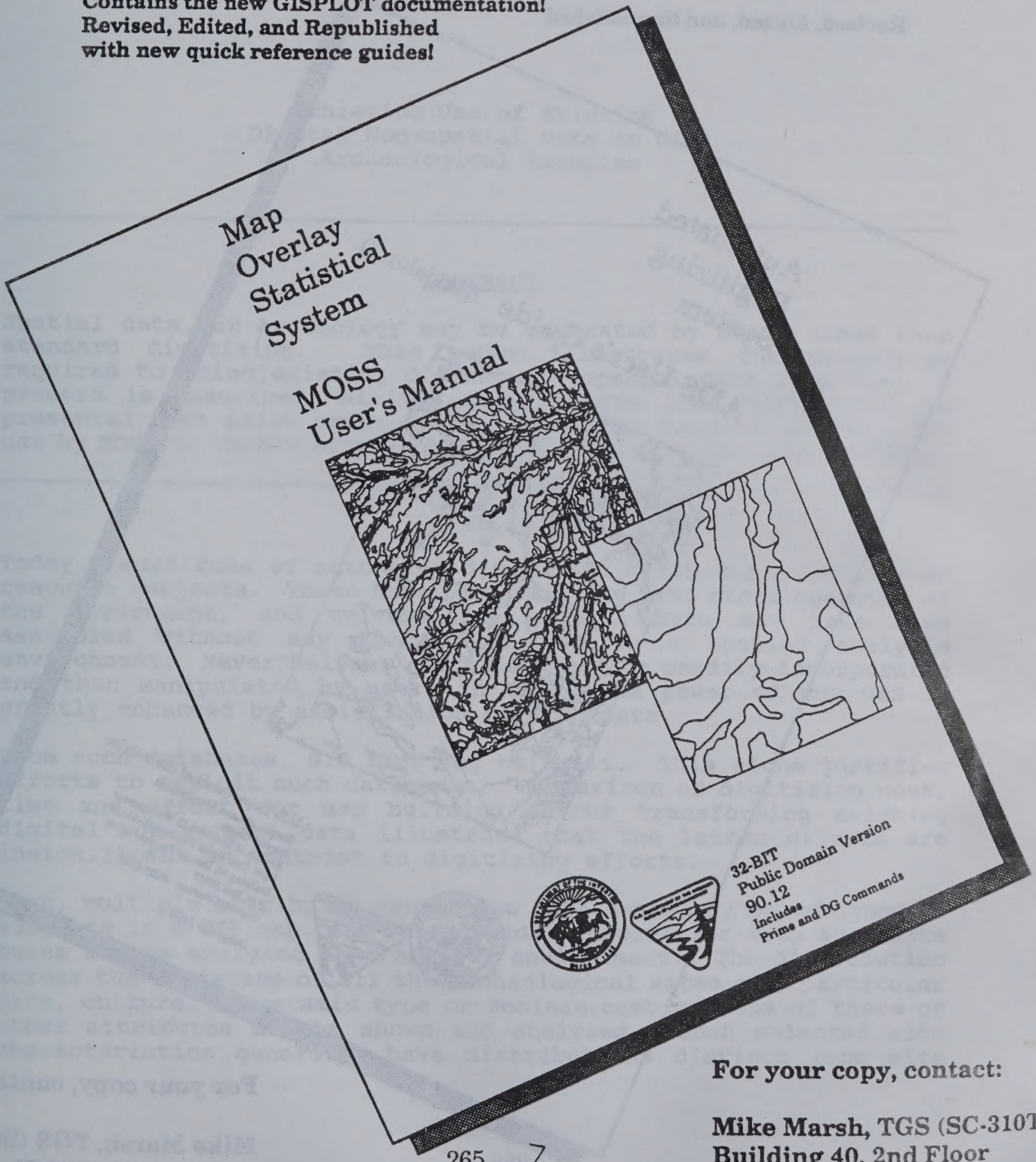
Example of output using the POINT option of the **ZOOM** command:

Resolution is increased over the previous plot.

New Release

The Map Overlay Statistical System
MOSS User's Manual
Version 90.12
Including Prime and DG Commands

Contains the new GISPLOT documentation!
Revised, Edited, and Republished
with new quick reference guides!



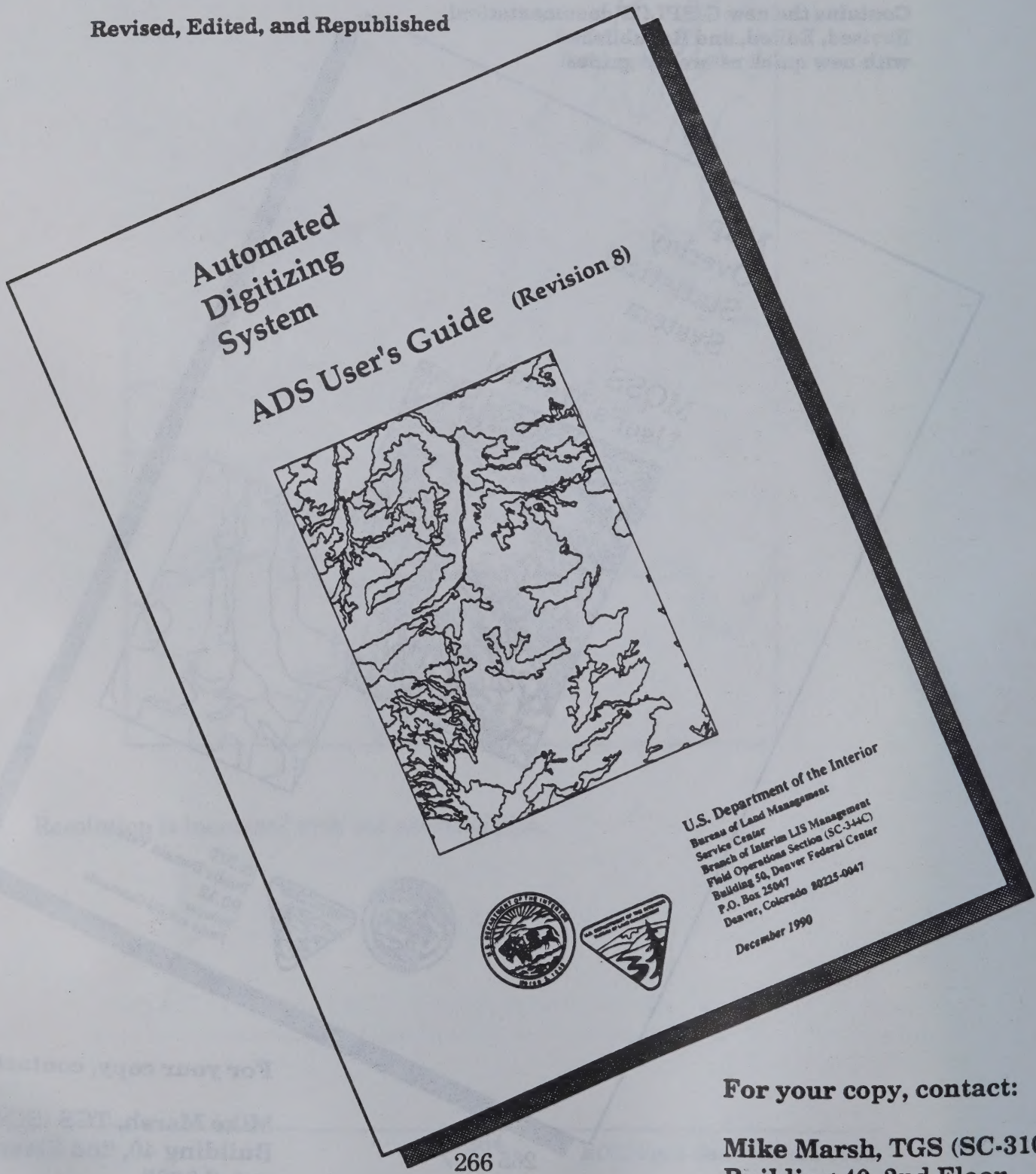
For your copy, contact:

Mike Marsh, TGS (SC-310T)
Building 40, 2nd Floor
ext. 6-9387

New Release

The Automated Digitizing System
ADS User's Guide
Revision 8

Revised, Edited, and Republished



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(SC-344C)

Achieving Use of Existing Digital Non-spatial Data in GIS: Archeological Examples

ABSTRACT

Spatial data for Archeology may be generated by means other than standard digitizing. This paper illustrates the procedures required to bring existing digital non-spatial data into GIS. A process is described. Minimal command sets from ORACLE will be presented that allow producing files in the formats suitable for use by MOSS to create maps and to link attributes to MOSS subjects.

Today a multitude of automated data bases exist for a variety of resource subjects. These have been built by BLM, other agencies of the government, and universities. Such data may have been assembled without any thought of use in a spatial analysis environment. Nevertheless, such data may be readily incorporated and then manipulated by users in GIS. The power of any GIS is greatly enhanced by assimilation of such data.

From such databases, GIS maps may be built. This alone justifies efforts to exploit such databases. Comparison of digitizing cost, time and effort for map building versus transforming existing digital non-spatial data illustrate that the latter efforts are insignificant in contrast to digitizing efforts.

Also, multiple attributes from these data bases may be assigned to subjects in a GIS map. In other words, information from such data bases may be analyzed in a spatial environment. The distribution across the landscape of all the archeological sites of a particular date, culture, or ceramic type or Boolean combinations of these or other attributes may be shown and analyzed. Such selected site characteristics generally have distributions distinct from site

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location alone. Once selected these distributions of site characteristics in space may be related to other GIS themes such as soils, elevation, slope, aspect, etc..

BLM archeologists maintain a set of site characteristics that are basic and are used frequently such as "site type", "national register status" or "BLM use categories". Beyond these data types, archeologists must tailor their spatial data requirements to the problem to be solved. An example is interest in the distribution of sites with visible architectural features and their proximity to roads. This information would answer questions about sites suitable for public display in recreation use.

Another question for the BLM archeologist centers upon defining butchering stations versus tool manufacturing sites. Important criteria might be sites with lithics having no decortication, primary thinning dominant, secondary thinning/shaping rare, final shaping rare, and cores rare. The needed information for this question resides in the Intermountain Antiquities Computer System (IMACS). This automated data base is subscribed to for the BLM states of Utah, Idaho, and Nevada.

Existing automated data bases for a site location may include data on architectural features, cultural affiliations, artifacts present, collections made, vandalism, components, date, features, recorder, sample strategies used, etc. On-line storage of some 50 or more recorded data elements in a multiple attribute file will likely not be desirable from a system space management standpoint. Therefore, use of the procedures described herein seems necessary as data requirements for new problems are met. It will likely will become commonplace for field users to perform the functions described here.

I will now assume from the brief introduction above that you are convinced that using such data bases with MOSS is in your, your users, and the BLM's best interest. You may have had such an interest before. Having gone beyond whether or not to do this work new questions arise. Who can do this work? How difficult is it? What skills are required? And <u>how</u> is it done? Allow me to answer the first three question by dealing with the <u>how</u> to do this work. Understanding the task will enable you to judge who among your users are capable of the work.

Before I lose the interest of those of you who are aware of very

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(SC-344C)

desirable existing digital non-spatial data that is without any "x,y" coordinates, consider this. If a data base has no assigned coordinates but the information does relate to location, a user may create other data base fields (x,y) and add the geo-coordinate data. Identification of a BLM resource data base that would have no spatial orientation whether or not identified in the data base is difficult to imagine. If keyboard entry of new fields of "x,y" data is not feasible, you may wish to digitize the coordinate data and exploit the other information by incorporating it into MOSS as multiple attributes. Users also have the option of establishing their data as ORACLE tables and using such data bases through the MOSS/ORACLE capability in lieu of multiple attributes.

Let's examine the processes required to 1) build a map and 2) incorporate multiple attributes into GIS. You will see that this is a multi-step, but not a difficult process. We will examine the command sequence in SQL/ORACLE essential to achieving the necessary format. We will work through the MOSS commands to generate maps and multiple attributes.

The following page is **Step 1 a, ORACLE to MOSS** Make a map showing the ORACLE/SQL commands used to put the data into a suitable format. This is followed by **Step 1 b** "Example of Map Making" using MOSS commands, page 1 through 6. Next is **Step 2 a,** Bring in your ATTRIBUTES again showing the ORACLE/SQL commands used to put the data into a suitable format for this function versus map building. Finally, **Step 2 b** "Example of an Attribute Definition File" (one page) and "Example of Attribute Creation" , page 1 through 6.

Step 1 a ORACLE to MOSS

Make a map.

Cause ORACLE to create an X,Y,SUBJECT file with the following command set:

```
SQL> SET PAGESIZE 0
SQL> SET HEADING OFF
SQL> SET FEEDBACK OFF
SQL> COLUMN EAST FORMAT 999999
SQL> COLUMN NORT FORMAT 9999999
SQL> SPOOL SITES1.EXP
SQL> SET TERMOUT OFF
SQL> SELECT EASTING EAST, NORTHING NORT, SITEID
  2  FROM SITELOC WHERE ZN = '13';
```

[This will generate a file that looks like this:]

```
259780 4372480 5GF01243
253180 4370660 5GF01244
260120 4374160 5GF01287
260320 4373140 5GF01288
254480 4371180 5GF01291
254420 4371300 5GF01292
254060 4371390 5GF01293
260080 4374120 5GF01295
260580 4373560 5GF01297
254340 4371620 5GF01298
252850 4370700 5GF01300
261660 4374860 5GF01308
261420 4374245 5GF01312
260100 4375000 5GF01325
254370 4371470 5GF01326
260230 4375070 5GF01327
260020 4374730 5GF01328
259870 4372530 5GF01231
260110 4373700 5GF01232
254110 4370840 5GF01233

SQL> SPOOL OFF
SQL> QUIT
Disconnected from Prime ORACLE Rev V5.1.22.1-21.0 - Production
OK, LD SITES@@

<SC3410>DAN (ALL access)
462 records in this directory, 33865 total records out of quota of 40000

1 File.
name              date/time modified     size  type  rbf
-------------------------------------------------------------------------
SITES1.EXP        15 May 90 10:41:48        1  dam

OK, COPY SITES1.EXP DAN>MOSS>==
```

```
17 May 90 14:49:56 Thursday
 WELCOME TO THE X,Y,SUBJECT REFORMATING PROGRAM
 WHAT IS THE NAME OF THE X,Y,SUBJECT DATA FILE?
SITES1.EXP

SITES1.EXP                              IS THE INPUT FILE

 ARE THE COORDINATES IN
  1) DECIMAL DEGREES
  2) METERS OR FEET
 ENTER 1 OR 2
2

 ENTER 1 FOR POINTS, 2 FOR LINES
: 1
 WHAT IS THE FORMAT OF THE X,Y,SUBJECT DATA FILE?
 FIRST VALUE IS X, SECOND IS Y, SUBJECT IS THIRD
 X AND Y COORDINATES USE F FORMAT, EG. F10.2, F8.4
 SUBJECT USES A# FORMAT, EG. A30, A8
 USE TABS TO INDICATE STARTING POSITION IN DATA FILE,
  EG. T10, T33. ENCLOSE THE ENTIRE FORMAT STATEMENT IN
 PARENTHESIS, EG.
     (T30,F9.3,T10,F8.2,T50,A10)

 IN THIS EXAMPLE, THE X COORDINATE STARTS IN THE
 30th POSITION, USES 9 SPACES, AND 3 OF THOSE
 SPACES ARE TO THE RIGHT OF THE DECIMAL.
 THE Y COORDINATE STARTS IN THE 10th POSITION, USES 9 SPACES,
 AND 2 OF THOSE ARE TO THE RIGHT OF THE DECIMAL.  THE
 SUBJECT STARTS IN THE 50th POSITION AND USES 10 SPACES.

         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345
259780 4372480 5GF01243

 WHAT IS THE FORMAT OF THE X,Y,SUBJECT FILE?
(T1,F6.0,T8,F7.0,T16,A8)
 THE FORMAT IS (T1,F6.0,T8,F7.0,T16,A8)

 XYZ.IMP  IS THE IMPORT FILE

 USE THE MOSS IMPORT COMMAND TO CREATE A MAP.
 THERE ARE    20 ITEMS IN THE FILE
**** STOP
```

```
          MAP OVERLAY AND STATISTICAL SYSTEM
          *8908 32 BIT RELEASE* W/9001 PATCH

 PRIMOS version 22.0.1.DOI / F77 Rev. T1.3-21.0 REQUIRED
   "NEWS" COMMAND PROVIDES CURRENT SYSTEM INFORMATION

  IF YOU HAVE ANY PROBLEMS, CALL YOUR STATE GIS OFFICE
  IN EMERGENCIES,  CALL THE GIS HOTLINE: (FTS) 776-0990
                                         (303) 236-0990


GRANDJ is a valid MOSS MASTER PROJECT.

    ************************************
   *          FIELD VERSION             *
  *  32 BIT MOSS FOR PRIMOS  22.1.DOI    *
  *  Use only the 32 Bit 89.08 Manual    *
   *         *8908* 1/25/90             *
    ************************************
ENTER COMMAND ?  DELETE CULTEMP

  WORK MAP: CULTEMP
 DATA TYPE =      1 NUMBER OF ITEMS =    20
 DO YOU WISH TO DELETE THIS FILE (Y OR N)
: Y
ENTER COMMAND ?  DELETE CULTLAM

  WORK MAP: CULTLAM
 DATA TYPE =      1 NUMBER OF ITEMS =    20
 DO YOU WISH TO DELETE THIS FILE (Y OR N)
: Y
```

```
ENTER COMMAND ?  IMPORT XYZ.IMP
 What do you wish to call the new map ?
 _________
: CULTEMP
 Enter NAME of map to use as a template for the new map header
 or enter CARRIAGE RETURN to start map header from scratch
:

 ENTER SOURCE OF MAP  [                    ]
: CULT DATABASE
 ENTER  CREATION DATE  [         ]
: 05/17/90
 ENTER  STUDYAREA NAME [         ]
: GJRA
 ENTER  DESCRIPTION
 [                                                              ]
 ______________________________________________________________
: SMALL MAP OF 20 SITES IN ZONE 13 TO CHECK ALLIGNMENT
 ENTER  MAP VINTAGE  [     ]
: 1990
 ENTER NUMBER OF SUBJECTS [     1]
: 20
 ENTER COORDINATE SCALE FACTOR [     100.0000]
:

        MAP PROJECTION


  # 0 PROJECTION IS GEOGRAPHIC(LON/LAT)
    COORDINATE UNITS ARE: DEGREES

 DO YOU WISH TO CHANGE THE PROJECTION DESCRIPTION [N]
: Y

 PROJECTION(0-20) ?
1

 ELLIPSOID(0-19) ?

 LONGITUDE OF ANY POINT WITHIN THE UTM ZONE ?
-107
 LATITUDE OF ANY POINT WITHIN UTM ZONE   13 ?
40
```

```
 IS THIS HEADER INFORMATION CORRECT [Y]
: Y
   ENTER DATATYPE

   1 = POINT                    11 = (X,Y,Z) POINT
   2 = LINE                     12 = (X,Y,Z) LINE
   3 = POLYGON                  13 = (X,Y,Z) POLYGON
   5 = SAMPLE ELEVATION POINT
: 1

 EXECUTING...PLEASE WAIT

 IMPORT COMPLETE FOR THE NEW MAP: CULTEMP
    20 ITEMS AND    20 SUBJECTS IN THE NEW MAP

 THE INPUT FILE IS XYZ.IMP
 DO YOU WISH TO DELETE THE INPUT FILE  [N]
: N
**** STOP

ENTER COMMAND ?  FREE ALL
ENTER COMMAND ?  SELE CULTEMP AL
    20 ITEMS FOR ACTIVE ID     1
ENTER COMMAND ?  PROJECT 1
 What do you wish to call the new map ?

: CULTLAM
 WHAT IS THE PROJECTION OF THE INPUT MAP ?

         MAP PROJECTION

  # 1 UNIVERSAL TRANSVERSE MERCATOR
      COORDINATE UNITS ARE: METERS
 VALUES OF ENTERED PARAMETERS
 ----------------------------
 ELLIPSOID SELECTED IS TYPE                              0
 SEMI-MAJOR AXIS OF ELLIPSOID                6378206.4000000
 ECCENTRICITY SQUARED OF ELLIPSOID                 0.0067687
 ZONE                                                     13
 LONGITUDE                                      -107.0000000
 LATITUDE                                         40.0000000
 Press CR to continue?
```

```
 WHAT IS THE PROJECTION FOR THE OUTPUT MAP ?

                        MAP PROJECTION MENU

  0 GEOGRAPHIC(LAT/LON)
  1 UNIVERSAL TRANSVERSE MERCATOR   11 LAMBERT AZIMUTHAL EQUAL AREA
  2 STATE PLANE                     12 AZIMUTHAL EQUIDISTANT
  3 ALBERS CONICAL EQUAL AREA       13 GNOMONIC
  4 LAMBERT CONFORMAL CONIC         14 ORTHOGRAPHIC
  5 MERCATOR                        15 VERTICAL NEAR SIDE PERSPECTIVE
  6 POLAR STEREOGRAPHIC             16 SINUSOIDAL
  7 POLYCONIC                       17 EQUIRECTANGULAR (PLATE CARREE)
  8 EQUIDISTANT CONIC A & B         18 MILLER CYLINDRICAL
  9 TRANSVERSE MERCATOR             19 VAN DER GRINTEN I
 10 STEREOGRAPHIC                   20 OBLIQUE MERCATOR (HOTINE)

 PROJECTION(0-20) ?
4

                    ELLIPSOID MENU

 0 CLARKE 1866 (default)    10 MODIFIED EVEREST
 1 CLARKE 1880              11 MODIFIED AIRY
 2 BESSEL                   12 WALBECK
 3 NEW INTERNATIONAL 1967   13 SOUTHEAST ASIA
 4 INTERNATIONAL 1909       14 AUSTRAILIAN NATIONAL
 5 WGS 72                   15 KRASOVSKY
 6 EVEREST                  16 HOUGH
 7 WGS 66                   17 MERCURY 1960
 8 GRS 1980                 18 MODIFIED MERCURY 1968
 9 AIRY                     19 SPHERE OF RADIUS 6370997 M

 ELLIPSOID(0-19) ?

 LATITUDE OF 1ST STANDARD PARALLEL ?
37
 LATITUDE OF 2ND STANDARD PARALLEL ?
42
 LONGITUDE OF CENTRAL MERIDIAN ?
-109
 LATITUDE ORIGIN OF PROJECTION ?
36
 ENTER FALSE EASTING IN SAME UNITS OF MEASURE
 AS THE SEMI-MAJOR AXIS OF ELLIPSOID
5000000
 ENTER FALSE NORTHING IN SAME UNITS OF MEASURE
 AS THE SEMI-MAJOR AXIS OF ELLIPSOID
0
```

```
        MAP PROJECTION

  # 4 LAMBERT CONFORMAL CONIC
      COORDINATE UNITS ARE: METERS
 VALUES OF ENTERED PARAMETERS
 ----------------------------
 ELLIPSOID SELECTED IS TYPE                              0
 SEMI-MAJOR AXIS OF ELLIPSOID                6378206.4000000
 ECCENTRICITY SQUARED OF ELLIPSOID                 0.0067687
 LATITUDE OF 1ST STANDARD PARALLEL                37.0000000
 LATITUDE OF 2ND STANDARD PARALLEL                42.0000000
 LONGITUDE OF CENTRAL MERIDIAN                  -109.0000000
 LATITUDE ORIGIN OF PROJECTION                    36.0000000
 FALSE EASTING                               5000000.0000000
 FALSE NORTHING                                    0.0000000
 Output projection satisfactory (Y/N) [CR=Y] :
Y

 ENTER SOURCE OF MAP  [CULT DATABASE        ]
:
 ENTER  CREATION DATE  [05/17/90]
: 05/17/90
 ENTER  DESCRIPTION
 [SMALL MAP OF 20 SITES IN ZONE 13 TO CHECK ALLIGNMENT          ]
 ____________________________________________________________
: SMALL MAP OF 20 SITES IN LAMERT PROJECTION FOR LOCATE
 ENTER COORDINATE SCALE FACTOR [    100.0000]
:

 IS THIS HEADER INFORMATION CORRECT [Y]
:
 PROJECTING...PLEASE WAIT
**** STOP

ENTER COMMAND ?  SELECT RBYGJRA AL
   145 ITEMS FOR ACTIVE ID     2
ENTER COMMAND ?  SELE CULTLAM AL
    20 ITEMS FOR ACTIVE ID     3
ENTER COMMAND ?  BYE


  USER DAN  EXITING MOSS
**** STOP
```

Bring in your ATTRIBUTES

First, thoroughly examine your map to see that sites relate spatially to other themes such as LLD, streams, roads, etc.. Then, cause ORACLE to create rows of data related to each site with columns for each attribute. The files should look like this:

```
5GF01108  ISOLATED FIND      G&K          82  S1425a RADIOACTIVE MATERIALS
5GF01109  ISOLATED FIND      G&K          82  S1425a RADIOACTIVE MATERIALS
5GF01447  ISOLATED FIND      BLM-GJRA     82  S1395a GJRA PRED MOD
5GF01448  ISOLATED FIND      BLM-GJRA     82  S1395a GJRA PRED MOD
5GF01446  ISOLATED FIND      BLM-GJRA     82  S1395a GJRA PRED MOD
5GF01084  ISOLATED FIND      BLM-GJRA     82  S1395a GJRA PRED MOD
5GF00113  HISTORIC           ARCH ASSOC   87  S313b W CEN COLO COAL
5GF00114  OPEN CAMP          ARCH ASSOC   78  S313b W CEN COLO COAL
5GF00115  OPEN CAMP          ARCH ASSOC   77  S313b W CEN COLO COAL
5GF00116  OPEN CAMP          ARCH ASSOC   78  S313b W CEN COLO COAL
5GF00274  ISOLATED FIND      ARCH ASSOC   78  S313c W CEN COLO COAL
5GF00161  ISOLATED FIND      ARCH ASSOC   78  S313c W CEN COLO COAL
5GF00162  ISOLATED FIND      ARCH ASSOC   78  S313c W CEN COLO COAL
```

The CPL that generates such a file from ORACLE is:

```
OK, SLIST ATTRGF.CPL
DELETE GFATTR.COMO
COMO GFATTR.COMO
DELETE GFATTR.LIS
DATE
&DATA SQL -SILENT SPRACULT/DODADAY
SET LINESIZE 100
SET HEADING OFF
SET FEEDBACK OFF
SET PAGESIZE 0
COLUMN RECORDER FORMAT A16
COLUMN YR FORMAT A3
SPOOL GFATTR
SELECT SITEID, SITETYPE, RECORDER, YR, PROJECTID
FROM SITECOMP WHERE SITEID LIKE '5GF%';
SPOOL OFF
QUIT
DATE
COMO -E
&END
&RETURN
OK,
```

```
OK, DOWN MOSS
You are now attached to <SC3430>DAN>MOSS
OK, LD CULT.DEF

<SC3430>DAN>MOSS (PDALURWX access)
17555 records in this directory, 19762 total records out of quota of 0.

1 File.
name              date/time modified     size  type  rbf
-------------------------------------------------------------------------
CULT.DEF          21 May 90 14:56:20        1  sam

OK, SLIST CULT.DEF
SITEID
SITE IDENTITY
3
8
(T1,8A)
1
SITETYP
SITE TYPE
3
19
(T11,19A)
1
RECORD
SITE RECORDER
3
16
(T31,16A)
1
YEAR
YEAR OF INVENTORY
3
3
(T48,3A)
1
PROJID
PROJECT IDENTITY
3
30
(T52,30A)
2
OK,
```

```
          MAP OVERLAY AND STATISTICAL SYSTEM
          *8908 32 BIT RELEASE* W/9001 PATCH

 PRIMOS version 22.0.1.DOI / F77 Rev. T1.3-21.0 REQUIRED
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    ************************************
   *          FIELD VERSION             *
  *  32 BIT MOSS FOR PRIMOS  22.1.DOI    *
  *  Use only the 32 Bit 89.08 Manual    *
   *         *8908* 1/25/90             *
    ************************************
ENTER COMMAND ?  STATUS JOB

 MOSS VERSION 32E STATUS INFORMATION
 DATE: 05/21/  90        TIME: 15:03:29

 MASTER DIRECTORY                = GRANDJ
 MASTER PROJECT                  = GRANDJ
 NUMBER OF ACTIVE MAPS           =     2
 NUMBER OF SELECTED ITEMS        =    40
 NUMBER OF LINES PER PAGE        =    24
 DISPLAY DEVICE                  = @CONSOLE
 TERMINAL TYPE                   = TEKTRONIX 4107 or TTERM
 SEGMENTS STATUS                 = DISABLED
 DEFAULT COLOR NUMBER            =     1
 DISPLAY WINDOW
   MIN X VALUE (WEST BORDER)  =      5096974.00000000
   MIN Y VALUE (SOUTH BORDER) =       383626.37500000
   MAX X VALUE (EAST BORDER)  =      5105580.00000000
   MAX Y VALUE (NORTH BORDER) =       388339.00000000
   RANGE EAST TO WEST         =         8606.00000000
   RANGE NORTH TO SOUTH       =         4712.62500000
```

```
ENTER COMMAND ?  UTIL


 ENTER MOSS UTILITY OPTION
   1  =  TERMINATE UTILITY SESSION   [DEFAULT]
   2  =  DATABTEST    (MOSS MAP NAMES SUPPORT)
   3  =  ATTRIBUTE    (MOSS MULTIPLE ATTRIBUTE SUPPORT)
   4  =  ATTDES       (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
   5  =  SUB2AT       (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
   6  =  APROJ        (MOSS MAP NAMES PROJECTION ASSIGNMENT)
   7  =  BROWZ        (MOSS MAP NAMES HEADER LISTING)
   8  =  PLOT.LEGEND  (BUILD PLOTTER LEGEND FILE)
   9  =  MAKE.LOGO    (BUILD PLOTTER LOGO FILE)
  10  =  SUBEDIT      (MAP SUBJECT EDIT PROGRAM)
  11  =  SET.LEVEL    (BUILD POLYCELL TRANSLATION FILE)
  12  =  TRANSFORM    (TRANSFORM COORDINATES TO A PROJECTION)
  13  =  QUAD         (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
  14  =  DLG3         (USGS DLG ASCII TO MOSS)
  15  =  MAPIDX       (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
  16  =  XYSUBJECT    (REFORMAT POINT DATA TO MOSS)
  17  =  ATT2SUB      (ATTRIBUTE TO SUBJECT)
: 3
```

```
 PLEASE ENTER MAP NAME
: CULTLAM

 THE NUMBER OF ATTRIBUTES IS      0
 THE NUMBER OF ITEMS IS          20

 PLEASE ENTER DESIRED OPTION
  1  =  EXIT   [DEFAULT]
  2  =  ADD A NEW ATTRIBUTE
  3  =  UPDATE AN EXISTING ATTRIBUTE
  4  =  CHANGE/DELETE KEY OR DESCRIPTOR
  5  =  LIST ATTRIBUTE FIELDS
  6  =  SEARCH AN ATTRIBUTE FIELD
  7  =  RESEQUENCE INPUT DATA FILE
  8  =  DELETE THE ATTRIBUTE FILE
: 7
 ENTER THE SOURCE OF ORDER FOR THE ATTRIBUTE FILE
  1 = Exit [Default]
  2 = Map  CULTLAM
  3 = File CULTLAM.OUT
: 2
 Enter name of data file to be resequenced:
GFATTR.LIS
 Enter START and STOP column positions (START# STOP#)
 of the matching subject field in the data file
: 0 9
 Enter SUBJECT search start position [1]
:
 RESEQUENCING, PLEASE WAIT...

 THESE SUBJECTS IN THE INPUT DATA FILE HAVE NOT BEEN USED:
  5GF01108    ON LINE      1
  5GF01109    ON LINE      2

ET CETERA

  5GF01078    ON LINE    287
  5GF01076    ON LINE    288
  5GF01075    ON LINE    289


 THE NAME OF YOUR RESEQUENCED DATA FILE IS: GFATTR.LIS.RES


 THE NUMBER OF ATTRIBUTES IS      0
 THE NUMBER OF ITEMS IS          20
```

```
 PLEASE ENTER DESIRED OPTION
  1  =  EXIT   [DEFAULT]
  2  =  ADD A NEW ATTRIBUTE
  3  =  UPDATE AN EXISTING ATTRIBUTE
  4  =  CHANGE/DELETE KEY OR DESCRIPTOR
  5  =  LIST ATTRIBUTE FIELDS
  6  =  SEARCH AN ATTRIBUTE FIELD
  7  =  RESEQUENCE INPUT DATA FILE
  8  =  DELETE THE ATTRIBUTE FILE
: 2
WILL YOU BE USING A DEFINITION FILE? [CR = NO]
: Y
 ENTER THE NAME OF THE ATTRIBUTE DEFINTION FILE
CULT.DEF
 PLEASE ENTER THE NAME OF THE INPUT DATA FILE
GFATTR.LIS.RES

 THE NUMBER OF ATTRIBUTES IS     5
 THE NUMBER OF ITEMS IS         20

 PLEASE ENTER DESIRED OPTION
  1  =  EXIT   [DEFAULT]
  2  =  ADD A NEW ATTRIBUTE
  3  =  UPDATE AN EXISTING ATTRIBUTE
  4  =  CHANGE/DELETE KEY OR DESCRIPTOR
  5  =  LIST ATTRIBUTE FIELDS
  6  =  SEARCH AN ATTRIBUTE FIELD
  7  =  RESEQUENCE INPUT DATA FILE
  8  =  DELETE THE ATTRIBUTE FILE
: 5
 PLEASE ENTER OPTION:
  1 = TERMINATE ATTRIBUTE BROWZE   [DEFAULT]
  2 = LIST INDIVIDUAL ATTRIBUTE BY KEY NAME
  3 = LIST INDIVIDUAL ATTRIBUTE BY ID NUMBER
  4 = LIST ATTRIBUTE HEADER INFORMATION

: 3
```

```
 PLEASE TYPE IN THE ATTRIBUTE ID
: 1
 ATTRIBUTE LIST
 ------------------------------------------------------------------------
 ID =        1
 ------------------------------------------------------------------------
 KEY = SITEID
 ------------------------------------------------------------------------
 THE DESCRIPTOR =
 SITE IDENTITY
 ------------------------------------------------------------------------
  THE DATA TYPE IS CHARACTER STRING
 ------------------------------------------------------------------------
 ENTER 1 FOR OBTAINING ALL ITEMS
 ENTER 2 FOR BOUNDED SEARCH
: 1
 FEATURE  VALUE
      1   5GF01243
      2   5GF01244
      3   5GF01287
      4   5GF01288
      5   5GF01291
      6   5GF01292
      7   5GF01293
      8   5GF01295
      9   5GF01297
     10   5GF01298
     11   5GF01300
     12   5GF01308
     13   5GF01312
     14   5GF01325
     15   5GF01326
     16   5GF01327
     17   5GF01328
     18   5GF01231
     19   5GF01232
     20   5GF01233
 PLEASE ENTER OPTION:
  1 = TERMINATE ATTRIBUTE BROWZE   [DEFAULT]
  2 = LIST INDIVIDUAL ATTRIBUTE BY KEY NAME
  3 = LIST INDIVIDUAL ATTRIBUTE BY ID NUMBER
  4 = LIST ATTRIBUTE HEADER INFORMATION


 THE NUMBER OF ATTRIBUTES IS     5
 THE NUMBER OF ITEMS IS         20
```

```
 PLEASE ENTER DESIRED OPTION
   1  =  EXIT   [DEFAULT]
   2  =  ADD A NEW ATTRIBUTE
   3  =  UPDATE AN EXISTING ATTRIBUTE
   4  =  CHANGE/DELETE KEY OR DESCRIPTOR
   5  =  LIST ATTRIBUTE FIELDS
   6  =  SEARCH AN ATTRIBUTE FIELD
   7  =  RESEQUENCE INPUT DATA FILE
   8  =  DELETE THE ATTRIBUTE FILE
:
**** STOP


 ENTER MOSS UTILITY OPTION
    1  =  TERMINATE UTILITY SESSION   [DEFAULT]
    2  =  DATABTEST    (MOSS MAP NAMES SUPPORT)
    3  =  ATTRIBUTE    (MOSS MULTIPLE ATTRIBUTE SUPPORT)
    4  =  ATTDES       (BUILD MULTIPLE ATTRIBUTE DEFINITION FILE)
    5  =  SUB2AT       (SUBJECT TO MULTIPLE ATTRIBUTE INPUT)
    6  =  APROJ        (MOSS MAP NAMES PROJECTION ASSIGNMENT)
    7  =  BROWZ        (MOSS MAP NAMES HEADER LISTING)
    8  =  PLOT.LEGEND  (BUILD PLOTTER LEGEND FILE)
    9  =  MAKE.LOGO    (BUILD PLOTTER LOGO FILE)
   10  =  SUBEDIT      (MAP SUBJECT EDIT PROGRAM)
   11  =  SET.LEVEL    (BUILD POLYCELL TRANSLATION FILE)
   12  =  TRANSFORM    (TRANSFORM COORDINATES TO A PROJECTION)
   13  =  QUAD         (MAKE A QUAD MAP IN IMPORT/EXPORT FORMAT)
   14  =  DLG3         (USGS DLG ASCII TO MOSS)
   15  =  MAPIDX       (MAKE INDEX MAP OF PROJECT IN IMPORT/EXPORT FORMAT)
   16  =  XYSUBJECT    (REFORMAT POINT DATA TO MOSS)
   17  =  ATT2SUB      (ATTRIBUTE TO SUBJECT)
:


   MOSS UTILITY SESSION COMPLETED


ENTER COMMAND ?  BYE


   USER DAN   EXITING MOSS
**** STOP
```

GIS Data File Production Tracking

or

Widget, Widget, Who's got the Widget

Mike Moscoe,
Management Analyst
Oregon State Office, BLM,
Western Oregon Digital
Database Project

When the BLM began the WODDB project, we expected to have to track 32,000 township files in AutoCAD. As the need to include ADS and MOSS files appeared, that grew to 100,000. Now by converting many themes from Township to District or even Western Oregonwide themes, we are reducing the number of files to track to a more manageable number of 8,000 to 10,000.

The subject of this presentation is the joys and sorrows of tracking 80 base and resource themes files for 377 townships, or, on some days, 490 through as many as 75 production processes.

Henry Ford pioneered the idea of mass production, but old Hank had it easy compared with what we have to do.

When a pickup comes off the assembly line, a glance will tell you if it has tires or a windshield. A quick look under the hood tells if you have an engine. Can anybody tell me if the files on this disk have been edgetied so that they snuggle up to the area geographically next to them on earth without embarrassing overlap or gaps?

Why develop a Tracker for your Project

If your area of coverage is small, if your number of themes are few, if you are going to do it all in house and you will probably run into every person involved in the project in the parking lot every day, you probably could succeed without a Project Tracker. I wouldn't try it without a tracker, but you might, and you might not have too many problems.

However, if the same file will go though a number of steps at different times, e.g. edgetie, close poly, line check, DBLinking, edit, revise, and reedit, it is nice to have some place where you keep track of where that little sucker has been.

Similarly, if he does something to it, then she does something to it, then we do something to it and finally they do something to it, a tracker comes in very helpful when they're still waiting for it, and we thought we finished with it three months ago and the boss wants to know why it isn't finished.

A tracker is not for keeping score. It's a map that helps you make the map. It can help you avoid having to cover the same territory twice.

Problems to consider when designing a Tracker

Plan the work and work the plan. Everybody here has heard that good piece of advice. If you're like my wife, with a near neurotic need to control or to organize, it's tempting to sit down at the beginning of the project and design the ultimate tracker that will take you from day one to where you expect to be at the end of the project, whether that be one or five years down the line. A word of Advice. Don't

I spent Christmas and New Years 1988, both the days and the Saturday and Sunday around them at the office, building a 16 megabyte tracker, affectionately called MONSTER. A month later it was obsolete, and worthless.

GIS project change, in the early stages of WODDB, we changed the production steps and processes every three or four months. And there were good reasons for those changes.

Technology fails. The users guide says you can do this. You get ready to do it, and it wont. Maybe your data is in the wrong formate. Maybe there's a bug in

the software, or the hardware has a problems. Let's face it, GIS is at the cutting edge of technology growth, and that means failures too. The MONSTER I donated my Christmas and New Years to complete died because the technology wasn't there. We had to develop a work around, and that changed the steps we wanted to track the data through.

Technology also advances. Somebody comes back from a conference. They've seen the Mountain Top and this new bit of software or hardware will half the cost of data capture. This, of course changes the steps and procedures again, but what the heck.

Of course, it also introduces a new learning curve and untested equipment, see the material covered under Technology Failure.

Then there is always the client. Some old timer, or young turk, waltzes into the office. "Geeze, I never figured you'd get this far in a year. You remember how we agreed to handle my data after that meeting a year ago, Well...

Here you can fill in the blanks.

I was at a conference, and talked to a guy, and they're doing this in Kalamazoo.

OR Some of us over coffee got together last week, and now that it really looks like you're going to have data for us, we think it ought to be done like this.

OR This bill just got signed by the governor, and we need to do things a we bit differently.

And that "we bit differently" means sending the data back out to the field for a second review, building a attribution file, designing and running a macro. All this will add at least six months to the project and at least a dozen production steps that weren't there a month ago.

The solution to this type of problem is the short interval forecasting approach. Let your tracker grow with you. Design it as you go alone. Put most of your effort into what you can see for the next three or four months (or whatever distance you feel you have a solid handle on) Schedule and track for that. Each month, review what you have done and decide whether you are ready to go a bit further.

Keep this idea in mind as we talk about what to track and how.

What to Track

Here you run into the inevitable debate between lumpers and splitters. What do you track. Our production people came up with what they called the "Process Listings" These laid out every action that had to be done to every file. Some of these actions took fifteen seconds. Tracking each and every one of those actions would have taken more time than doing them.

Of course, there is the opposite. June 1, we'll start the process. July 1, we'll deliver all 490 townships on that day. Trust me, we can do it. I've reached the point where I don't trust water to flow down hill.

Track whenever the file changes hands. In our case, that was mailed to or from the District Office. Track whenever the file changes process or, as happened to us, completes one process and is shelved pending the completion of software for the next process.

After much talk and argument, we finally settled on a tracker that has thirty-two fields. It was both too many, and too few. Many of the files turned out to be so simple, they moved from activity 8 to activity 16 in one or two days. Most of the intermediate columns got ignored. Eight or nine of the 32 did most of the work.

However, Rework killed us.

We expected a file to go out to the field, be QC'ed, come back, be corrected, then posted as Ready, Done, Finished.
Would have been nice if it had worked that way.

This didn't finish the Communications Cycle. The District who asked for a change, were not told of the change. When they stumbled on the revised file, they might or might not approve of the changes that we made.

We had one pathetic file go through five revisions, Some of which were productions fault, some the Districts, all of which took way to long to complete because there was no formal approval or QC process for revisions. Of course, how many rework cycles do you put in your central tracker.

Looking back on this, I would suggest a separate tracker for extra rework on files.

Use the tracker to set boundaries

One of the biggest problems we had with WODDB was setting the boundary of the project. "Would you mind doing just a little bit more to cover this problem." "We just remember, or discovered something we overlooked. How about doing this for us."

There are good reasons to lock down the tracker. If someone erroneously names Townships S3E4 as N3W4 or S4E3, if that township is not in the tracker, you know you have a problem. If someone can add a township to the tracker anytime they want to, you won't discover the problem for some time.

377 townships were included in the aerial photo coverage. Indians took back one, so you would think 376 was the boundary of the project. We had timber holdings in 113 townships that were not in the photo coverage. We did not have official surveys for the PLSS of those townships, but we juryrigged something for them. Called them X townships.

Then someone pointed out that there were twenty or thirty more where we had Recreation sites, some as small as a 1/4 acres.
I called them XX township, and considered them obscene and unfit for juvenile viewing.

I set up a separate tracker for the first group of X themes, but only for six themes. We weren't supposed to have any other themes for those X's. I set up no tracker for the XX's. Boy was I wrong.

We did that because our DBase III programmer told us all the themes had to have the same listing of Townships. If I had it to do over again, I'd create a Little Squirt Tracker for the worst of my leakers and add ons.

What do you track it with?

I don't care what you use to track the project, so long as everyone uses the same software to track it.

At one point we had one part of production using LOTUS 123 as a tracker, another group used DBase III. Management was very interested in when the project ended. They had me tracking it in a Project Management software called PROMIS. A lot of people were entering the same data in a lot of different places.

That doesn't mean that you use only once piece of software.

Project Management Software, is a powerful tool for managing a project. It answers crucial question, like when are we going to be done? What has to be ready before we can do this? If this doesn't happen by Christmas, what happens?

The project discipline that Project Management software enforces strikes me as a good thing. However, Project Management assumes certain things. Like you don't put in the fourth floor of a building before you put in the basement. Every software for Project Management I've ever met was based on a hierarchical database. GIS projects do not work in a 1 2 3 way.

For example: We sent five products a week out to the DO. Three weeks later, we got back one from week one, three from week two and one from week three. PM expects to get them back in the order they are shipped. The precedent network does not know what to do with the ones that come back early and the ones that come back late.

Since the project kept acting like a relational process, we found a relational Data Base, like DBase III was the best way to keep track of each individual file. When COUNT said we had five done, I went to a simplified Project Management simulation, told it the first week was done and then processed the network. It was happy, I was happy, my management was happy.

If we needed to know where one specific data file was, we went to the tracker. If we wanted to know when we would finish, we went to Project Management.

We also went to LOTUS regularly, for graphics that management could understand at a glance, and for various analysis of the data. This may have occurred because DBase III's reporting capability still has me buffaloed.

And, of course, there were times when the word processor was the simplest and easiest way to do some reports, especially when I was trying to track just a dozen townships that the tracker said were done and were not.

Simply put, the WODDB project was big enough to need every bit of software I could lay my hands on.

We began the project thinking tracking could be easily done. By mid project, we realized we had a major problem. By mid project, we were trying to catch a run away train.

I would strongly recommend that planning for tracking the production of the data be a major initial effort. Short interval planning can help you avoid over planning, but plan, Plan, PLAN.

IDENTIFYING HABITAT MOSAICS AND CHANGES AROUND NORTHERN SPOTTED OWL SITES ON BLM LAND IN WESTERN OREGON

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INTRODUCTION AND OVERVIEW

Joseph S. Meyer, Wildlife Biologist and professor at Humboldt State University, and two of his colleagues are currently doing research on how to manage for viable populations of the Northern Spotted Owl, and how to decide what extent and types of timber harvesting have the least effect on Spotted Owls. In the study, they are testing the null hypothesis that habitat characteristics do not affect 1) site selection, 2) site occupancy or 3) reproductive success of Spotted Owls at sites within the BLM land ownership and management in Western Oregon. They chose to analyze the BLM data set because it contains the largest number of owl sites for which adequate occupancy and reproduction surveys are available over a several-year period.

The objectives of this study are to 1) estimate several habitat indices at known Spotted Owl Sites; 2) test for differences between randomly-selected owl sites and randomly-selected landscape locations; and 3) test for correlation between habitat indices and occupancy or reproduction at Spotted Owl sites.

This paper will focus on how the BLM, more specifically the Western Oregon Digital DataBase, was able to assist Joe Meyer in his first objective - estimating habitat indices at Spotted Owl Sites.

Data on occupancy and reproduction at Spotted Owl sites in the 5 Oregon BLM Westside Districts were provided to the researchers by BLM biologists. Based on those lists, they chose 150 sites suitable for use in the study: 50 long-term data sites, 50 random owl sites, and 50 random landscape locations. The habitat mosaic for each site was mapped from 1985-1987 aerial photos by the Photogrammetry Branch at the Denver Service Center. Date of photography, State Plane Coordinates, elevation and dominant habitat type were recorded for 917 grid points within a 2.1-mile-radius circle around each site.

Since timber harvesting occurred at some sites during the 5-year study period, the habitat mosaic interpreted from an aerial photo taken in one year may not accurately represent the habitat mosaic in the other 4 years. After the habitat mosaics at all 150 sites have been mapped, habitat information will be updated with timber harvesting histories from 1985-1989, to account for major habitat changes that may have occurred during the 5-year period. This involves querying the Western Oregon GIS about timber harvesting activity at each of the grid points falling on BLM-administered land within a site.

However, the WODDB GIS contains habitat and timber-harvest information only for BLM-administered land. For land not administered by the BLM, 1990 aerial photos will be used to identify where new timber harvests (and forest fires) occurred since the 1985-87 aerial photos were flown. In order to do this, they will superimpose air photos onto 1:24,000 MOSS plots of each site, provided by the Oregon State Office. All timber harvests identified in the original aerial photos will have been traced onto these plots. Where new forest openings occur on non-BLM land, they will contact the owner or land manager to determine when that removal of vegetative cover occurred.

THE ROLE OF WODDB

So far, we have mentioned two ways in which the WODDB MOSSDATA was used:

1) To create a hardcopy map for each of the 150 sites showing:
   - the 917 grid points around the site
   - indication of ownership (BLM or non-BLM)
   - PLS grid surrounding the site.

2) To provide data from the GIS to update timber harvesting information for each of the grid points faling on BLM-administered land.

There is a third purpose for MOSS in this study, which will be discussed later in the paper, but first, details on how MOSS was used to accomplish these two.

PRELIMINARY WORK

Joe Meyer provided the Oregon State Office with an ASCII file for each site, giving the subject and x-y coordinates of each grid point. Preliminary steps to convert this data into a form usable by MOSS were:

1) PRIMELINK the raw ASCII data into the PRIME environment

2) Run a program written by David Mandel of Infotec which
   - reformats the data from SUBJECT,X,Y to X,Y,SUBJECT.
   - translates data from feet to meters
   - calculates the scale factor for importing.

3) Run MOSS XYSUBJECT to reformat the x,y,subject file into the MOSS Import ASCII file.

4) Run MOSS STNDRD to import the MOSS ASCII file into the MOSS Master DataBase.

MOSS STEPS

Once the master MOSS file was created for a site, the following steps were performed:

We created a MOSS plot using PENPLOT, for each study site, which showed: (Attachment 1 shows an example of the finished plot.)
- 917 grid points
- Row & Column references
- Ownership (indicated by shading for non-BLM land)
- PLS grid

In most cases, the 2.1-mile-radius circle of grid points around each site covered land on more than one township. Thus, we SELECTed and WINDOWed to PLS sections from each township involved and plotted at that WINDOW.

The resulting plots will aide Joe in determining where grid points fall on non-BLM land when he uses 1990 aerial photos to update timber harvesting information.

For each of the grid points in the study site, we provided information on type of ownership. For those points within BLM ownership, we also provided data on habitat type and timber harvesting.

We wanted to create a file containing this information for each point:

- subject of grid point (site#_row_column)
- type of ownership

For points on BLM land:
- Forest Operations Inventory data, such as:

Dominant Species	Denudation Date
Dominant Species Size	Birthdate
Cover Condition	Stocking Class

To achieve this, we had to run INTERSECTs of the site point file with Ownership and the FOI data. But first, we needed to BUFFER the grid points by 5 feet so that we would have polygon data for INTERSECTing.

We INTERSECTed the tiny grid polygons with Ownership, resulting in a file of 917 polygons with site and ownership information in the subject. In cases where the study site overlapped into 2 or more townships, we first MERGEd all ownership into one file, and INTERSECTed that with the grid polygon file.

Next, we took the grid/ownership file and INTERSECTed it with each FOI township file. For each township included, we had to do a separate intersection. This is because we wanted to keep the multiple attribute file associated with the OI. Had we MERGEd OI townships prior to INTERSECTing, we would have been unable to keep multiple attribute files associated with each OI file.

The result of the second intersection was a file of 917 polygons with site-subject/ownership/OI-unit-# in the subject, and the multiple attribute database from the Operations Inventory file.

The last step before we could produce a REPORT of all the information we needed was to do SUBJECT-TO-ATTRIBUTE in order to create 3 new attributes from the subject (site subject, type of OWNERSHIP, and OI Unit #), and then run ATTRIBUTE to add these new attributes to the existing multiple attribute database (from OI).

Finally, we ran a REPORT on each file, with a column for each of the attributes mentioned earlier (dominant species, ownership, etc.). This report will be used by Joe Meyer to gather information on timber harvesting for those grid points where changes had occurred on BLM land since the 1985-1987 aerial photos.

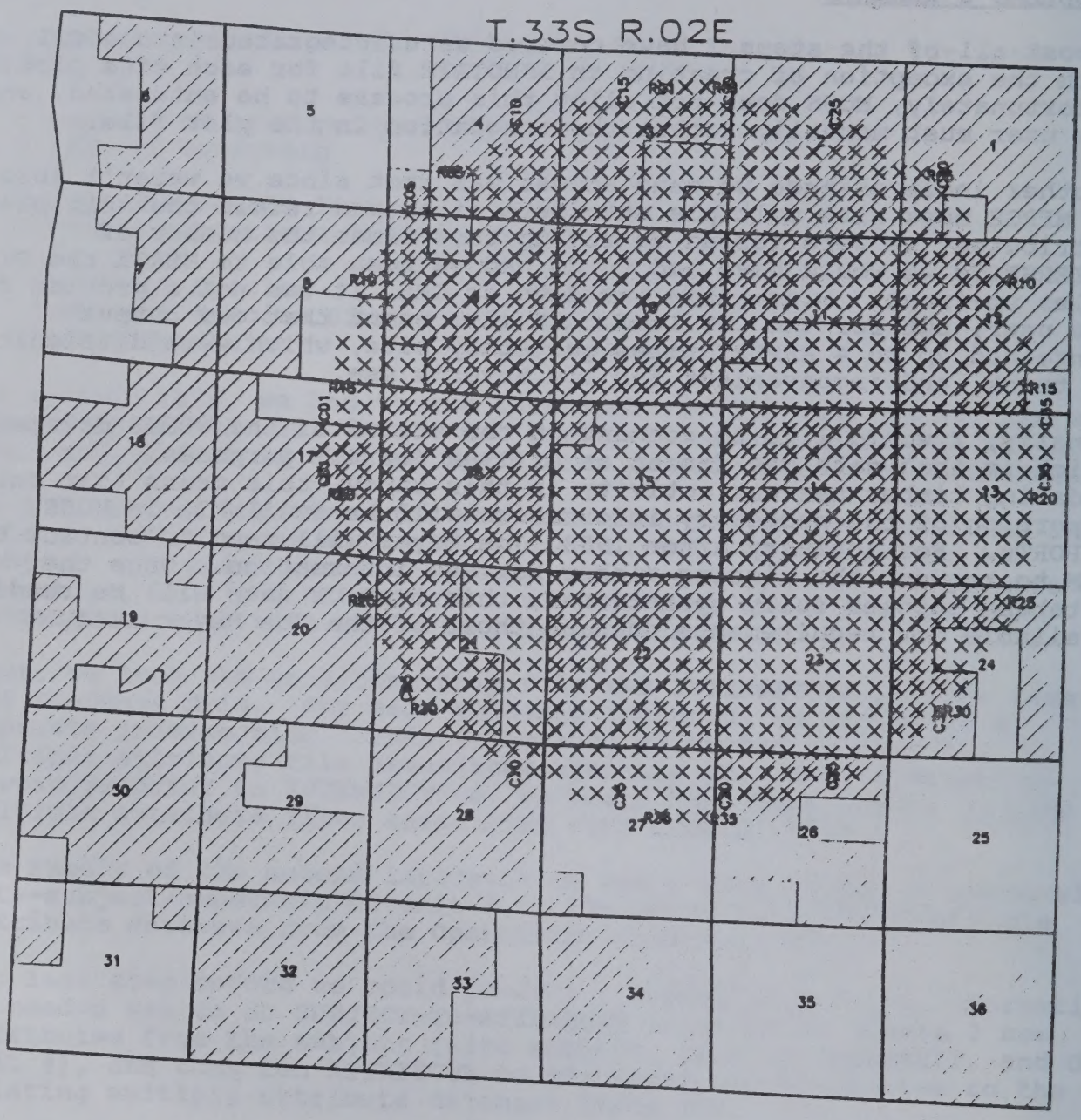
Earlier, I mentioned a third use for MOSS in the study, and the REPORT we created is also used for that. The report from MOSS will be used to cross-check habitat types identified by aerial photo interpretation for sections that the BLM manages. If considerable discrepancies are found, sites will be ground-truthed to test the reliability of habitat types assigned by aerial photo interpretation.

PROBLEMS & REMARKS

Almost all of the steps I have covered were integrated into a CPL, with the exception of creating an ANNOTATE file for each site plot. Unfortunately, MOSS does not allow this process to be automated, and the user must manually locate the annotation in the plot file.

Another inconvenience we came across was that since we weren't able to MERGE maps with multiple attribute files and retain the multiple attributes, we were forced do run up to 4 times the number of INTERSECTs we would have had to do had we been able to MERGE the OI files up-front. Since this was done by CPL, it was not a problem for the user, but for the CPU load. It also meant that our output contained up to 4 REPORT files per study site, which were difficult to track, and inconvenient for Joe Meyer's use.

Finally, I would like to comment on the status of the WODDB database, which is that data was frozen as of 1988 for RMP purposes. For updating timber harvest activity in this study, this means that only a portion of the necessary information will be available in MOSS REPORTs. For activity after 1988, Joe Meyer will need to contact the BLM to request the missing timber harvest information. Once the database becomes fully operational, this type of data will be readily available for requirements such as those of the Joe Meyer study.



MEYER STUDY SITE A20

Mining Claim Distribution Mapping Utilizing Legal Land Descriptions as A Link to MOSS

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Vernal District Office
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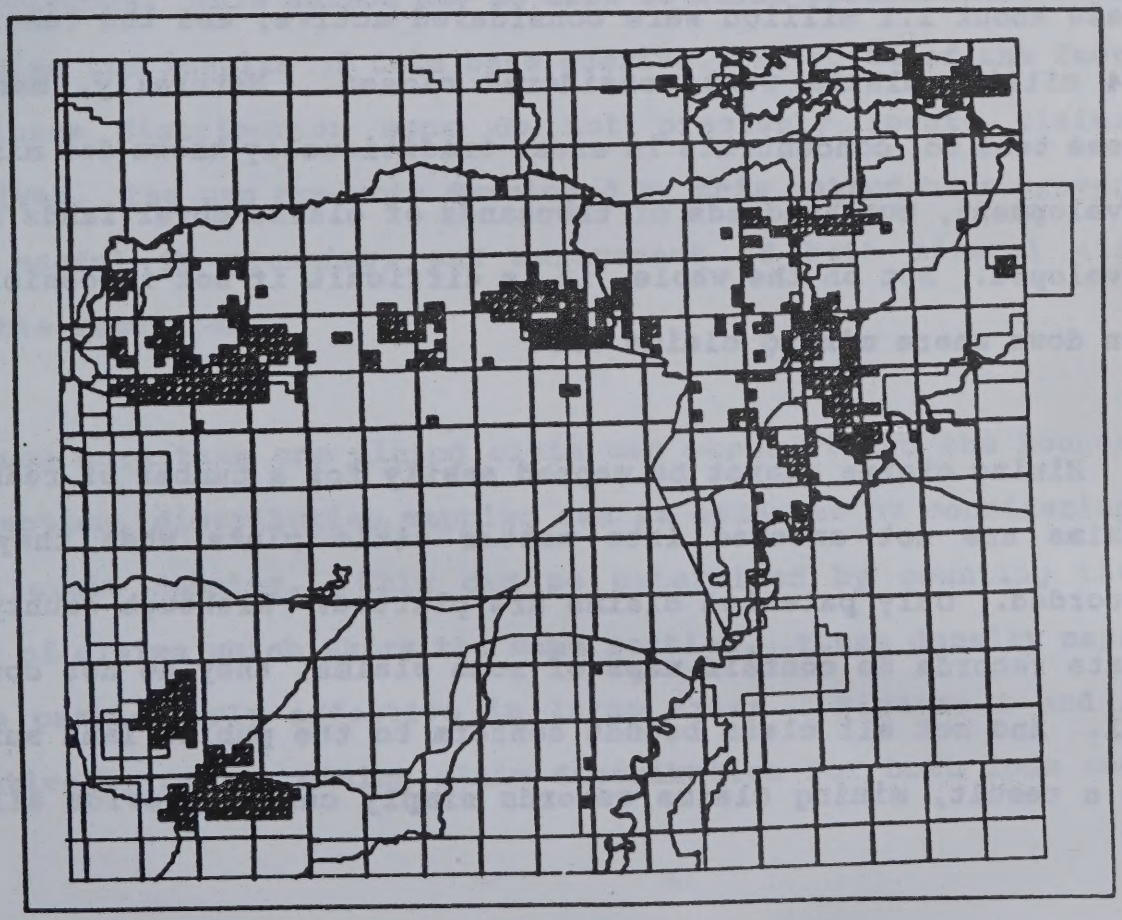


Mining claims, and the management of mining activities upon them, have become an important land management issue in the 1990's. Public attention has begun to focus more critically upon the mining law of 1872 which many regard as obsolete and incompatible with wilderness values, recreation, wildlife, and similar resource values. Consequently, greater emphasis is now being placed upon the management of minerals exploration and development on mining claims. As competition for public lands increases, it will become more and more important for land managers to know where claims are and where they are not.

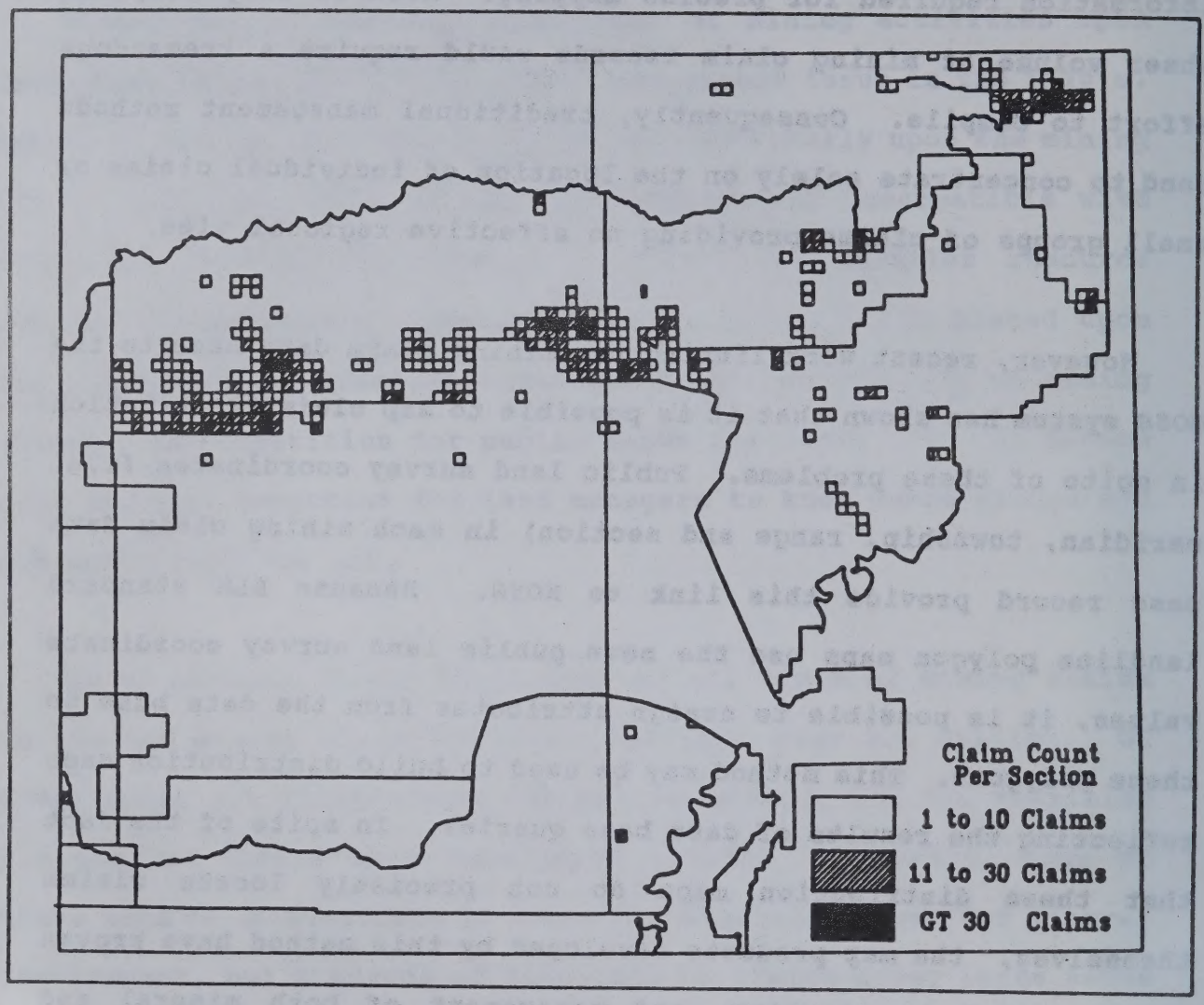
As of October, 1990, the number of all types of mining claims in the BLM mining claim data base was just over 2.5 million. Of these about 1.1 million were considered active, and the remaining 1.4 million claims were considered closed. Naturally, many of these tend to concentrate in areas traditionally known for mineral development, but hundreds of thousands of claims cover lands never developed. But on the whole, it is difficult if not impossible to pin down where mining claims are.

Mining claims cannot be mapped easily for a number of reasons. Claims are not entered into master title plats when they are recorded. Only patented claims are platted. Although county and state records do contain maps of some claims, they do not contain all. And not all claim bounds conform to the public land survey. As a result, mining claims records simply cannot provide all the

information required for precise mapping. Even if they did, the sheer volume of mining claim records would require a tremendous effort to compile. Consequently, traditional management methods tend to concentrate solely on the location of individual claims or small groups of claims providing no effective regional view.

However, recent work linking the mining claim data base to the MOSS system has shown that it is possible to map claim distribution in spite of these problems. Public land survey coordinates (i.e. meridian, township, range and section) in each mining claim data base record provide this link to MOSS. Because BLM standard landline polygon maps use the same public land survey coordinate values, it is possible to assign attributes from the data base to these polygons. This method may be used to build distribution maps reflecting the results of data base queries. In spite of the fact that these distribution maps do not precisely locate claims themselves, the map products developed by this method have proven to be useful in planning, and management of both mineral and renewable resources.

Since more than one mining claim can occur within the bounds of a section, distribution mapping can be enhanced by considering mining claim density. This can be determined by counting the number of claims which share the same section. These density maps can be particularly effective in large areas. Figures 1 and 3 respectively, depict mining claim distribution for both lode and



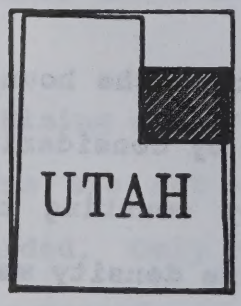
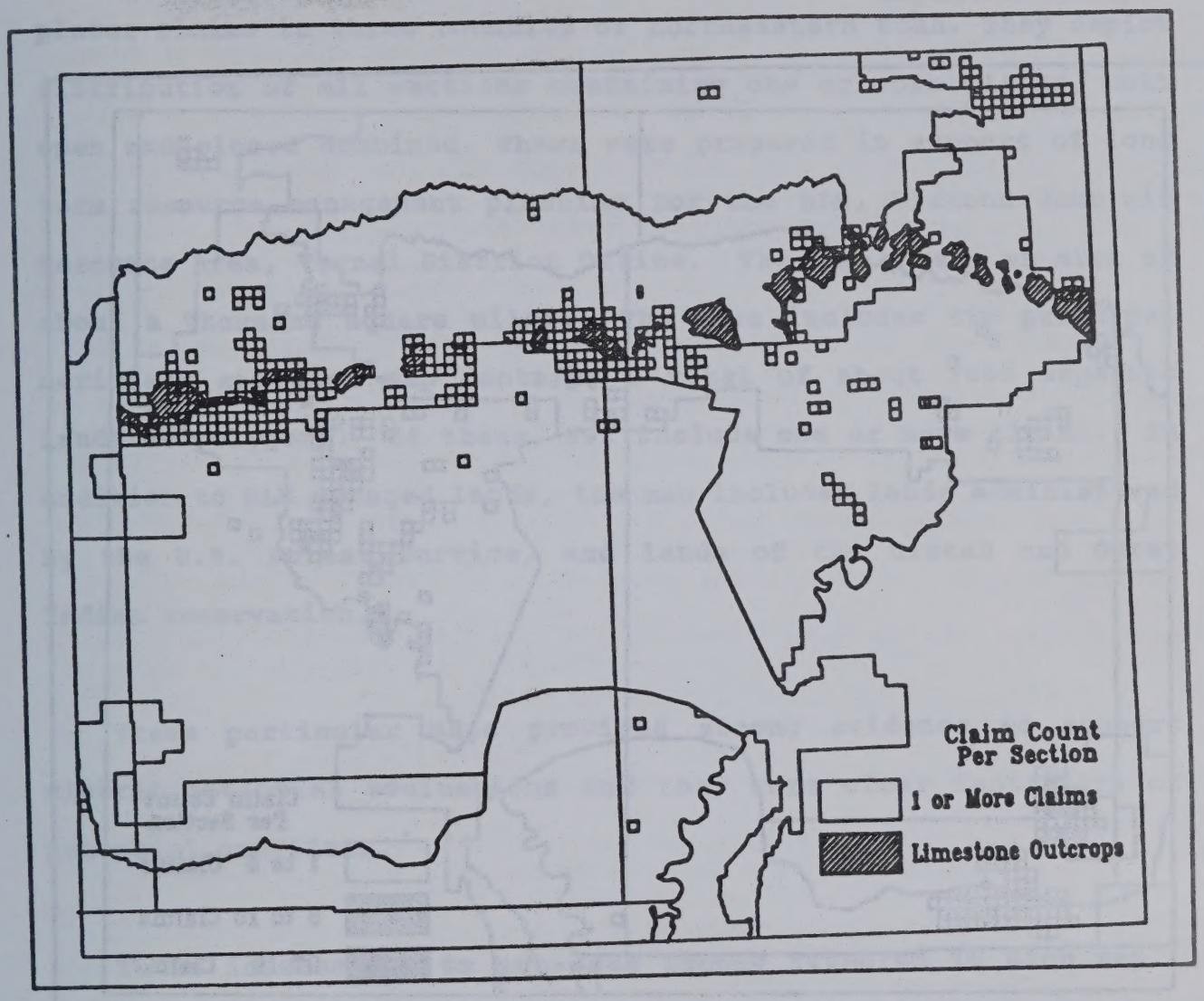


Figure 1, Lode mining claim distribution map, Northeastern Utah. Open and Closed mining claims. Spring, 1990, Scale 1:1,100,000. Forest Service, BLM and Indian Res. boundaries shown.



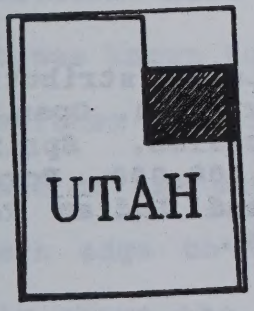
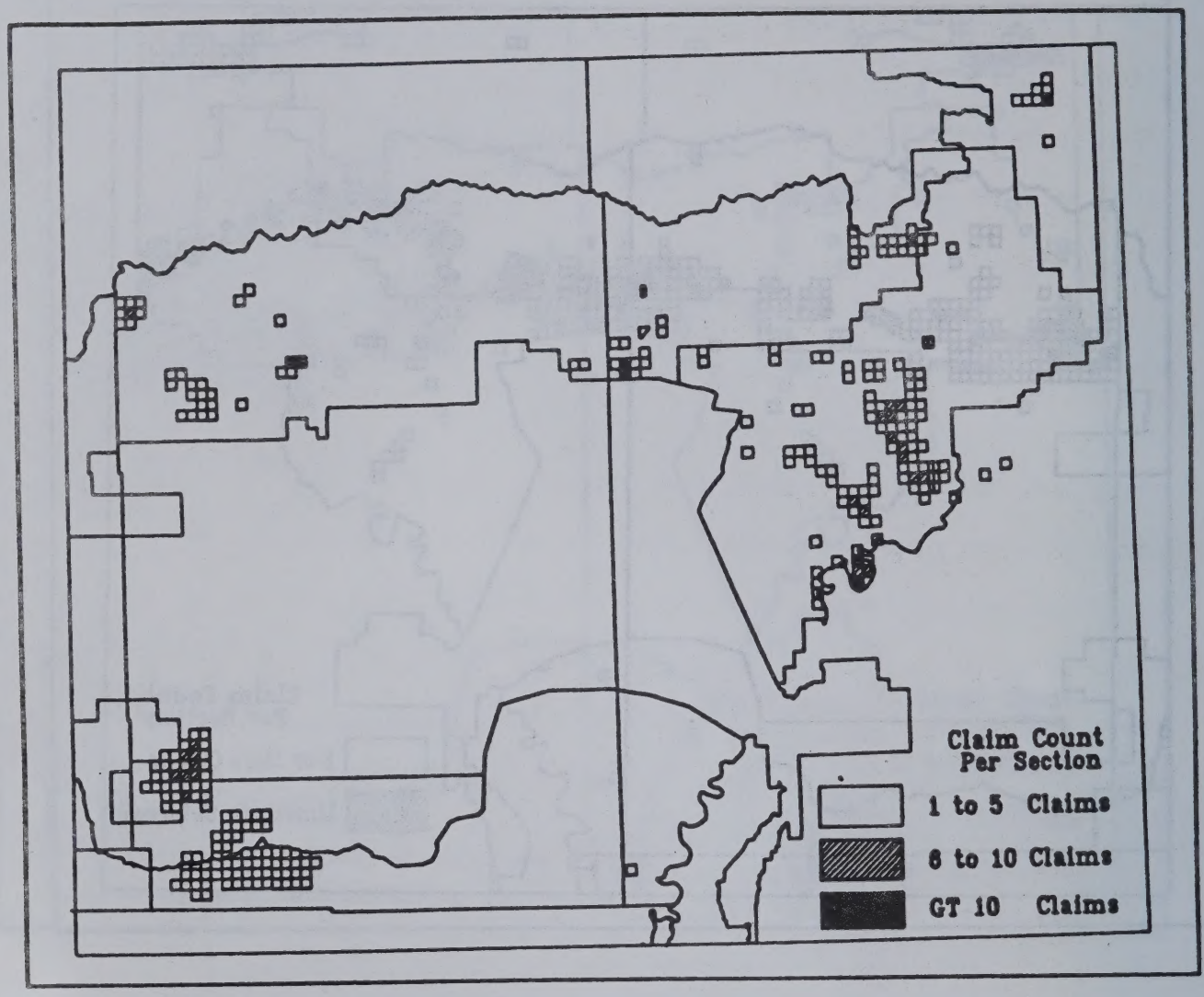


Figure 2, Lode mining claim distribution and outcrop pattern of Paleozoic Limestones with known potential for locatable minerals. Spring 1990, Scale 1:1,100,000.



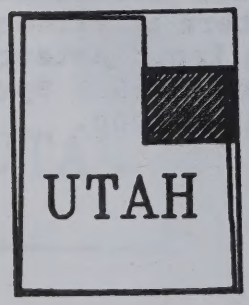


Figure 3, Placer mining claim distribution map, Northeastern Utah. Open and Closed mining claims. Spring, 1990, Scale 1:1,100,000. Forest Service, BLM and Indian Res. boundaries shown.

placer claims in three counties of northeastern Utah. They depict distribution of all sections containing one or more claims, both open and closed combined. These were prepared in support of long term resource management planning for the BLM, Diamond Mountain Resource Area, Vernal District Office. The map covers an area of about a thousand square miles. The area includes two principal meridians and each map contains a total of about 7000 separate landline polygons. Of these, 592 include one or more claims. In addition to BLM managed lands, the map includes lands administered by the U.S. Forest Service, and lands of the Uintah and Ouray Indian reservation.

These particular maps provided strong evidence to support mineral potential evaluations and they were clear indicators of potential conflicts.

It is interesting to note the trends revealed in each map. The dominant east west trend of lode claim density which crosses the northern third of the map (fig. 1) corresponds to outcrops of limestones known to have significant mineral potential. Figure 2 demonstrates this relationship. It shows lode claim distribution overlaid on the outcrop pattern of these limestones. The sharp southern edge to this trend on in the western half of the map clearly shows the boundary between Forest Service lands and the Uintah and Ouray Indian reservation. The large block of sections in the southwestern corner of the placer claim distribution map

(fig. 3) includes oil shale placer claims exclusively. Most placer claims conform to the public land survey, which is the case with these so, in this case, the block of sections shown is essentially the same as a map of the claims themselves.

Mining claim distribution maps are relatively simple to construct. The process here requires five basic steps. Steps two through four utilize Fortran routines written especially for each step. Many opportunities exist to streamline the programs and the overall process. However, the process as it stands offers current users the ability to take advantage of the power of GIS right now. The following outline lists the basic steps:

1.) Acquire the raw state data on tape from the BLM Service center.

- Build raw data disk file for all data (MAGNET).

2.) Extract and summarize all data for a user specified administrative area from the State data disk file, (Program GET_AREA).

- Build disk file of all mining claim records which occur in the mapping area.
- Summarize the number of claims in the area of interest.
- Discard the State disk files from step 1.).

3.) Count the number of claims which occur within each section within the mapping area. (Program COUNTCLAIM)

- Read GET_AREA output file and tally the number of occurrences of each claim type in each section.
- Write file containing the resulting tallies for all sections in the administrative area which contain one or more claims. Keep this file for future use.

- Discard the GET_AREA output file from step 2).

4.) Build multiple attribute file to match a user specified landlines polygon map, (Program BUILD_AT)

- Read MOSS polygon file and match legal land description subject with legal land description attribute in COUNTCLAIM output file.

- Write legal land description and associated count attributes to attribute file in sequence matching the MOSS polygon file.

- Repeat this step for any landlines polygon map in the administrative area until state data is refreshed.

5.) Attach the resulting attribute file to the map.

- Use MOSS utilities to add attribute file.

Nine track magnetic tapes containing the raw data may be obtained from the Bureau of Land Management Service Center, Technical and Administrative Records Section. Each order includes all mining claim records for a single state. The record format is contained in the appendix. This data is available in either ASCII (Honeywell Standard) or EBCDIC (IBM Compatible) format. The ASCII format is compatible with PRIME tape drives. Bureau of Land Management offices may order the data without cost. Other agencies, businesses and private individuals may be charged for the data. A schedule of fees may also be found in the appendix.

The tape data is initially downloaded to disk files using the PRIME MAGNET utility. No manipulation of the data takes place at this time. Each tape is written to separate disk file. For most states this can consume a large proportion of available disk space.

For instance, the data for Utah requires five nine-track tapes. This data consumed nearly 30 to 40 percent of the disk space on the Vernal PRIME Level C. Obviously, limitations to disk space may require work arounds. It is possible to modify the Fortran code in the following steps to read data directly from the tape files. This is a likely improvement to future programs. Direct links to the DPS8000 system would also be an improvement.

After each tape has been copied to the disk, the Fortran program GET_AREA copies selected records from each mining claim entry in these files. A claim entry is composed of a header record, location record(s), owner record(s) and action record(s). Header records describe claims by serial number, claim name, claim type and so forth. Location records follow the header record and include legal land description, state, county, and BLM administrative area. The number of location records may vary depending upon the extent of a claim. Owner records contain claim owner name and address. Action records include action codes, dates and remarks. Each of the four record types contains a record type flag.

GET_AREA processes each of the MAGNET disk files separately producing a separate output file corresponding to each. These GET_AREA output files are eventually concatenated, yielding a single file which will be used by the COUNTCLAIM program in the next step. For each claim entry in the files, the program reads

header and location records, transcribing these records to a user named output file, while ignoring the owner and action records.

GET_AREA transcribes only those records whose administrative area field matches the two character administrative area code which the user identifies. This may be a BLM District, Resource Area, or it can be a county. Future versions of GET_AREA could be redesigned to allow the user to be more selective. For example, in addition to specifying administrative area, the user could select for claims which meet other conditions such as county in addition to BLM administrative area. Other queries might identify all claims of a certain type which were recorded after a certain date. Naturally a modern data base programming language would be better suited for this kind of work, but for the time-being the GET_AREA Fortran code can be easily modified to meet specific needs.

In addition to data transfer, GET_AREA summarizes the data by tallying the number of records that occur for each claim type- lode, placer, millsite, tunnelsite, in the mapping area. This summary provides a good overview of mining claim activity in a given area.

After the GET_AREA files have been concatenated into a single file, the program COUNTCLAIM reads this file and compiles a tally of the number claims which occur in each section in the meridian

or meridians contained in the mapping area. COUNTCLAIM formats this tally and builds a file which may then be used by the program BUILD_AT to build a MOSS multiple attribute file. The tally includes claim counts for each claim type, i.e. lode, placer, millsite and tunnelsite.

The record format of the GET_AREA output file is essentially the same as the original data except owner records and action records do not exist in this file. The COUNTCLAIM program reads this file sequentially and evaluates each claim entry in the file. Again, each claim entry consists of a header record followed by one or more location records. As each header record is detected the program reads the claim type and claim status fields from this header record and then moves ahead to the following location record. The program then reads the legal land description fields and claim type from the location record. For each location record, the program converts the legal land description coordinate values to an array address and updates the appropriate claim counter in the array. After updating the counters, it moves on to subsequent records. The process is repeated each time a new header record is encountered or an end of file marker is encountered.

At a minimum, there must be eight such claim type counters for every section in the mapping area. Four of these hold claim counts for open claim types (lode, placer, millsite, and tunnelsite) and the other four hold closed claim counts. So COUNTCLAIM uses two

arrays to store these counters. One array reserved for open claim counts and the other for closed claim counts. The dimensions of each array are analogous to the meridian within which claim distribution is being mapped. This allows the program to convert legal land descriptions from the location records directly to array addresses.

The first two dimensions of the array correspond to the range width and township height of the meridian. The third dimension of the array corresponds to the thirty-six sections in each township. The fourth dimension contains four cells, one for each claim type. Array addresses corresponding to townships in the western and southern quadrants receive negative assignments; eastern and northern quadrants receive positive values. This is no problem since Fortran allows arrays to be dimensioned with both negative and positive values.

The following examples illustrate the relationship between the legal land description and the arrays. A two dimensional array cell address corresponding to Township 03 North, Range 25 East could be: 3,25. Therefore, Section 25 in this township would be addressed in a three dimensional array at 3,25,25. A lode claim counter for this section in a four dimensional array would then be addressed 3,25,25,1. A placer claim counter for the same section would be addressed 3,25,25,2; a millsite counter 3,25,25,3 and tunnelsite counter 3,25,25,4. The counter for ten open lode claims

in this section could be assigned to an array named OPENARRAY by the statement OPENARRAY(3,25,25,1) = 10. Similarly, twelve closed placer claims in Township 02 South, Range 10 West, Section 12 could be assigned with the statement CLOSEARRAY(-2,-10,12,2) = 12.

These arrays consume a tremendous amount of memory. To illustrate the potential size of each array, the Salt Lake Meridian is 30 townships high, by 20 ranges in width. The dimension statement for open and closed counter arrays corresponding to the meridian looks like this: DIMENSION SLMCOUNT(-23:3, 8:27, 36,4). The total number of cells required for this array would then be 30 x 20 x 36 x 4 = 86,400. Two arrays would then consume 172,800 cells.

This can cause some difficult problems on systems with limited memory. The problem is compounded in areas which cover more than one meridian since each meridian requires an additional array pair. Clearly, memory limitations could cause real problems for distribution maps which divide a meridian into lots and quarter quarter sections instead of sections.

If memory is a problem, the programs could be redesigned to handle blocks, or smaller portions of a meridian at a time. The arrays to handle the Vernal data clearly leave much of the space in the Salt Lake Meridian arrays empty since the mapping area

covers only one corner of the meridian. Therefore it would be more efficient to limit array dimensions to the minimum portion required to contain the largest possible map the user may want to map.

After COUNTCLAIM exhausts all of the available claim entries in the GET_AREA output file, the program writes claim counts to a disk file named by the user. Imbedded do loops allow the program to write each non-zero claim count value in each of the arrays to this sequential output file. Each non-zero occurrence in any of the four claim type cells, in either the open or closed array, causes the output of a single formatted record. On output the program converts the respective array coordinates back to township, range and section values matching the BLM landlines polygon legal description format. This value is written to the first field in each output record.

After the legal description string, each record includes ten claim count fields. Eight of these include claim counts for the four claim types, open and closed. Two additional fields include the total of all open counts and the total of all closed counts. There is no need to store the counts representing these totals in the open or closed arrays. These values may be calculated from the other eight.

The COUNTCLAIM output file now holds counts for all sections with one or more open or closed claims in the user selected

administrative mapping area. All previously created files may now be deleted unless the user wishes to repeat the GET_AREA and COUNTCLAIM programs for some other selected area. Generally this will not be necessary since the user will typically begin by selecting an entire resource area or district.

The COUNTCLAIM output file should be kept on file until new data tapes arrive. Using this file, claim distribution may be determined for any landlines polygon map inside the area covered by the output file. Typically a MOSS merge map of all polygon quads which cover this area will prove to be most useful, but a quadrangle size map would be just as suitable.

The BUILD_AT program matches landlines polygon maps with the COUNTCLAIM output file. The resulting BUILD_AT output file may be attached to the source polygon map as a multiple attribute file using the MOSS multiple attribute utility. Since the BUILD_AT sequences its output to match the item order in the MOSS polygon file, it is not necessary to resequence before attaching this file. Eliminating the need to resequence speeds processing for large maps.

BUILD_AT utilizes the same array structure COUNTCLAIM. After the user specifies the MOSS name, the program loads the entire COUNTCLAIM output file into open and closed arrays. This allows the program use the legal description in the map to quickly find

the corresponding count values. The program reads the polygon map file one record at a time. For each record, the program converts subject string into array coordinates. The array values at those coordinates are written along with the subject string to the BUILD_AT output file.

It should be noted that a significant problem can occur in BUILD_AT where a mapping area covers two meridians. If portions of each meridian share the same coordinates within the same map area it is impossible for BUILD_AT to differentiate between the two. COUNTCLAIM can handle this problem because the mine claim data records include a meridian indicator. BUILD_AT cannot, because the polygon map subject strings do not have such an indicator. Even in areas where shared coordinates are not a problem, shared meridians is and requires extra program steps to resolve the problem. The simplest solution to the problem would be to include a meridian indicator in each landlines polygon subject string.

As mentioned above, the MOSS multiple attribute utility attaches the BUILD_AT output file to the source landlines polygon map. This has no effect upon normal use of the polygon map. The multiple attribute file may be stored in the Master data base with the original polygon map. But now the BSEARCH command allows users to select various ranges of claim count values. The most simple selection by BSEARCH selects all polygons with count values greater

than zero. Shading of the resulting polygons yields a distribution map that may be useful for determining avoidance areas in planning. More discriminating searches yield maps showing claim density by claim type and status. Density maps result from BSEARCHing a number of successive ranges of possible claim count values.

To conclude, the process described here can undoubtedly be streamlined in a number of ways. Where modern database programs offer a flexible and dynamic environment suitable, inflexible Fortran routines seem just a little archaic. At each program step, it is clear that an integration of all steps into a whole would increase speed and usability. But, output from this prototype process demonstrates that legal land descriptions can effectively bridge the gap between large land management data bases and MOSS. It can provide land managers and minerals specialists with important, and previously inaccessible views of mining claim distribution.

This mapping technique could be applied to other data bases composed of a large number of elements. For instance, distribution maps of oil and gas leases would now be of value in some areas. Of course the parcel generator will eventually allow these leases to be plotted directly. But even then, on a regional basis, distribution and density mapping could be of some value in planning and management.

Development of the process revealed some important problems. Of these, the most important relates to the current standard for landline polygon subject labeling. Without a meridian designator, work with regional maps with shared polygons can be exceedingly difficult if not impossible. All landline polygon map subject strings must include a meridian code in order to be of full value.

Current versions of the Fortran programs described above may be obtained by contacting the author. The address of the Vernal District Office is:

Bureau of Land Management
Vernal District Office
170 South, 500 East
Vernal, Utah 84078

(801) 789-1362
FTS 326-1362

These programs are written specifically to suit the particular geographic setting of the Vernal District. They will require some modification before they can be used in other areas. In most cases this should not be too much of a problem and it would provide an opportunity for improvements. Please feel free to call or write if you have interest in preparing distribution maps in your own area.

Lastly, I would like to acknowledge Ms. JoAnn Stroh for her help with this project; without it it simply would not have been possible to complete.

Appendix

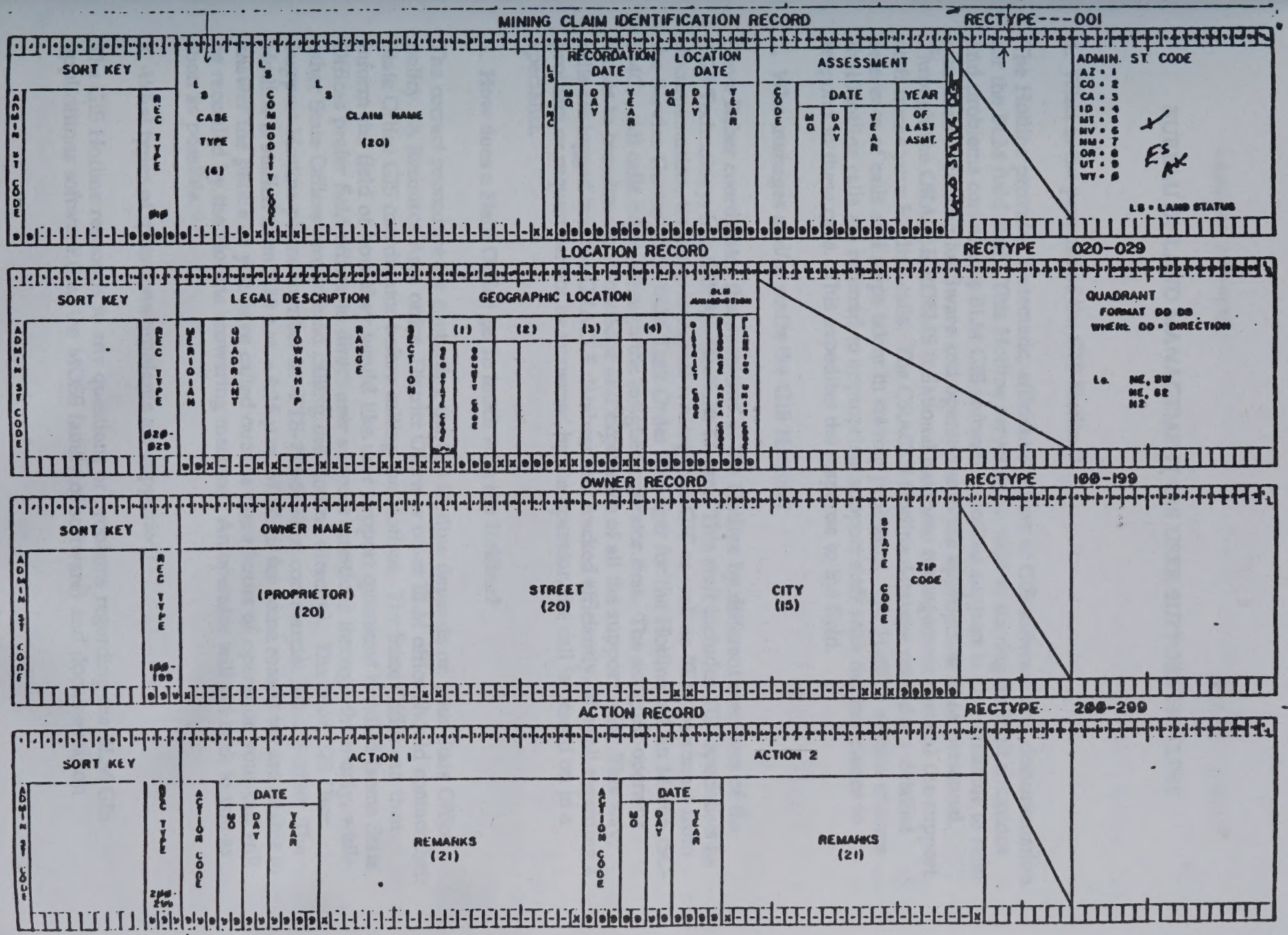
Nine track tapes may be ordered from the BLM service center according to the following fee schedule:

Arizona	$544.58
California	$416.28
Colorado	$447.82
Eastern States	$ 36.45
Idaho	$257.57
Montana	$244.50
Nevada	$821.15
New Mexico	$296.43
Oregon	$206.26
Utah	$629.78
Wyoming	$460.43

Orders may be placed with:

Ms. Cindy McCauley
BLM Service Center, SC-324B
P.O. Box 25047
Denver, CO 80225-0047

(303) 236-6634, FTS 776-6634


MINING CLAIM IDENTIFICATION RECORD
RECTYPE---001
SORT KEY
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LS COMMODITY CODE
LS CLAIM NAME (20)
LS INC
RECORDATION DATE
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DAY
YEAR
LOCATION DATE
ASSESSMENT
CODE
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YEAR OF LAST ASMT.
LAND STATUS CODE
ADMIN. ST. CODE
AZ • 1
CO • 2
CA • 3
ID • 4
MT • 5
NV • 6
NM • 7
OR • 8
UT • 9
WY • 0
LS • LAND STATUS
LOCATION RECORD
RECTYPE 020-029
LEGAL DESCRIPTION
MERIDIAN
QUADRANT
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(1)
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(4)
POINT CODE
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DLM ADMINISTRATIVE UNIT CODE
QUADRANT
FORMAT DD DD
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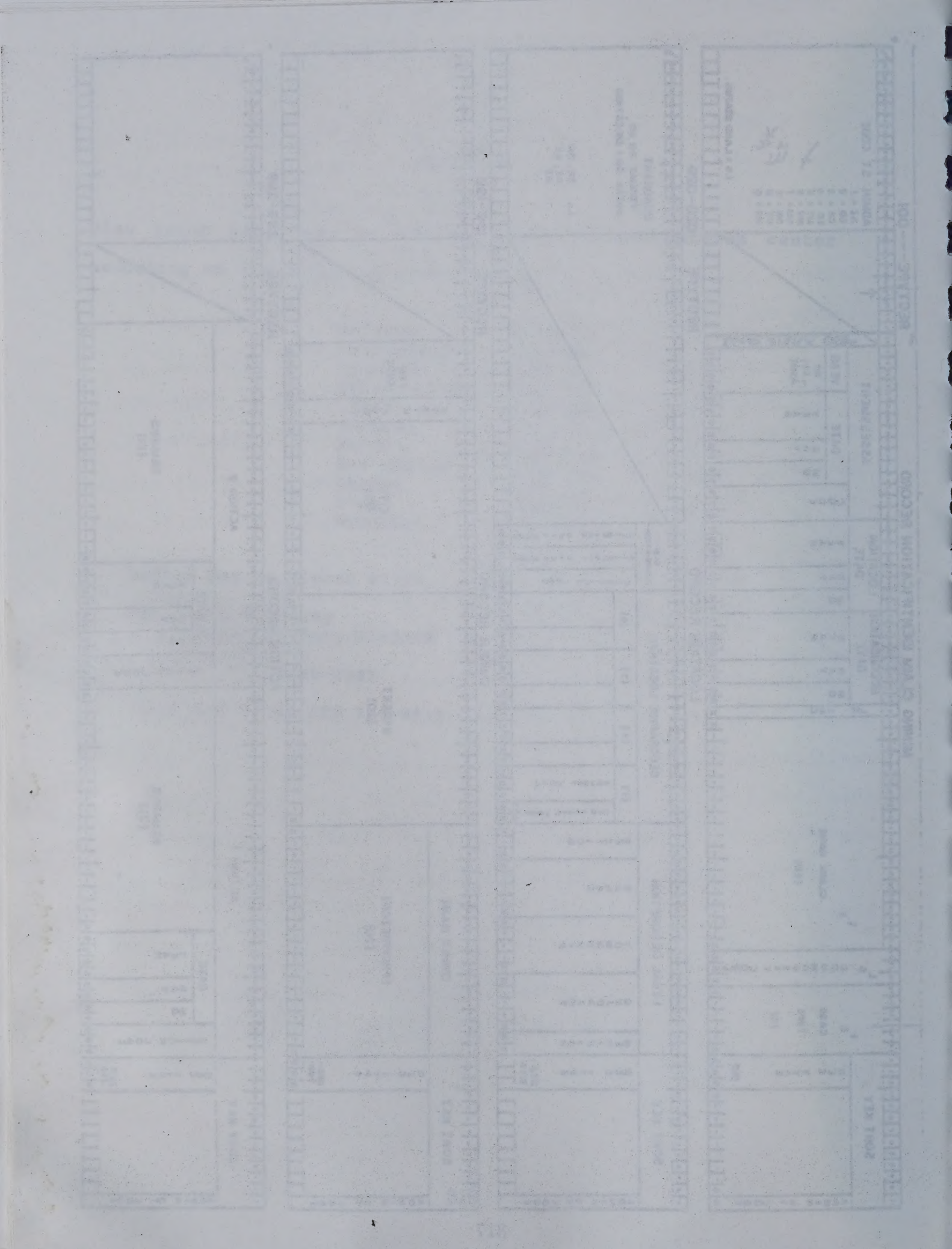
i.e. NE, SW
NE, SE
N2
OWNER RECORD
RECTYPE 100-199
OWNER NAME
(PROPRIETOR) (20)
STREET (20)
CITY (15)
STATE CODE
ZIP CODE
ACTION RECORD
RECTYPE 200-299
ACTION 1
ACTION 2
ACTION CODE
REMARKS (21)



BUREAU OF LAND MANAGEMENT GIS USER SUPPORT HOTLINE

1. What is the purpose of the GIS Hotline?

The Hotline provides systematic, efficient support of GIS software and documentation for the BLM field staff. This Hotline serves as an aide to solving difficult situations and problems concerning BLM GIS software. Hotline support is also available to refer questions regarding hardware and operations to the appropriate BLM personnel. Through the ORACLE RDBMS (relational database management system) the support staff tracks your Hotline calls. The ORACLE Hotline database provides a detailed reference of calls and steps taken in solving problems. The Hotline system ensures that Hotline calls are referred to appropriate support staff with the experience to respond to these calls. This expedites the response to the field.

2. Who manages and/or staffs the GIS Hotline?

Steve Raber coordinates the operation of the Hotline by different members of the TGS Technology, Inc. GIS Applications Group. This staff includes TGS specialists in documentation, training, technical writing and GIS as well as BLM personnel from the Service Center. The BLM Task Order Manager for the Hotline is Dan Martin (SC-344C). All calls come through the assigned operator first. The assigned operator varies to broaden the knowledge and experience of all the support staff. This way, calls are logged into the ORACLE database and tracked efficiently. If a call regarding a problem or request cannot be answered by the operator, the call is passed on to a specialist.

3. How does a Field Office get in touch with the Hotline?

The correct procedure for contacting the GIS Hotline depends on your State Office policy. A Resource Area office, District Office or other BLM office should contact their State Office GIS coordinator before calling the Hotline. The State Office can then inform the field of how they would like user support questions handled (some State Offices prefer field offices to direct user support questions through them only, while other State Offices recommend calling the Hotline directly). The BLM GIS User Support Hotline phone number is: **FTS-776-0990** or commercial **303-236-0990**. The Hotline is staffed from **7:30 a.m. - 4:15 p.m. MST**. If for some reason we are unable to answer the phone or you have called outside these hours of operation your call will be recorded by the Hotline answering machine. An operator will get back to you as soon as possible.

4. What types of questions/problems are supported?

The GIS Hotline responds to any questions or problems regarding the BLM GIS applications software (i.e., the MOSS family of software) and documentation.

5. How do you properly report bugs?

If you suspect that a bug is present in the software or documentation, you should thoroughly document the bug and be sure that it can be replicated a second time. It is helpful to submit your request by completing a 1260-4 Request for ADP Program and System Action form. Making a hardcopy of the problem (i.e. COMO file, plot, or tape file) also helps Service Center personnel find answers to problems more easily. You may call the GIS Hotline (following State Office policy) to inform the Service Center of a possible bug and to find out if that particular bug has already been reported. At the Service Center, the bug will be tested and officially reported to the Configuration Control Board. A possible error in any user manual should be reported immediately to the Service Center (via the Hotline) for verification and correction.

6. How does the ORACLE RDBMS help the Hotline service?

By using SQL*FORMS that allow entry of Hotline information, the ORACLE RDBMS allows us to store information for later retrieval. Service Center personnel can then query the database for specific details regarding Hotline calls. With the addition of FORTRAN programs that use SQL statements to query the database, Service Center personnel can search for information on a specific command or type of software. Queries can be made in other ways as well. For example, it is possible to find out the number of calls that came in for a specific month on the PENPLOT command and what the problems and solutions were.

The on-line forms are designed so that the Hotline operator can input the call's information (i.e. name, office, phone number, problem and solution) into the Hotline database. The information is then sent to the appropriate specialist via electronic mail on the PRIME. Specialists are assigned commands to support according to their expertise.

7. How long will a user have to wait for a response?

The GIS Hotline support policy is to return calls from the field as soon as possible after a Hotline call is assigned to the appropriate specialist. Sometimes a solution to a particular problem is provided at this time. Often, however, the specialist will require verification of the problem and a more complete understanding of the problem. Then, depending on the nature of the question, the specialist can provide an answer or conduct research and tests to find an answer. When a solution is found, the specialist or Hotline operator will contact the field caller. In any case, we will keep you up to date on the status of your problem.

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IMPLEMENTING THE SPATIAL DATA TRANSFER STANDARD

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ABSTRACT

Significant developments have occurred in the disciplines of cartography and geography in recent years with the advent of computer hardware and software that manipulate and process digital cartographic and geographic data more efficiently. The availability of inexpensive and powerful software and hardware systems offers the capability of displaying and analyzing spatial data to a growing number of users. As a result, developing and using existing digital cartographic data bases is becoming very popular. The absence of uniform standards for the transfer of digital spatial data is hindering the exchange of data and increasing costs.

Both the Federal Government and the academic community have been working over the last few years to develop a transfer standard for digital spatial data that includes definitions of terminology, a spatial data transfer specification, recommendations on reporting digital cartographic data quality, and topographic and hydrographic entity terms and definitions. This proposed standard was published in the January 1988 issue of *The American Cartographer*.

This paper will outline the contents of the standard; describe efforts to test and promote the standard; summarize activities to review and finalize the standard by a Technical Review Board composed of Federal Government, private sector, and university representatives; outline the Federal Information Processing Standard (FIPS) review and approval process; and discuss user interfacing with the standard.

Empirical testing of the standard was completed in early 1989. The standard underwent revision by the Technical Review Board as a result of the testing and peer review, and was submitted to the National Institute of Standards and Technology for approval as a FIPS publication in summer 1990.

This was a national effort to develop a spatial data transfer standard for use throughout the Federal Government that will have wide-ranging implications to the GIS community. Since the use of the standard makes it easier to transfer geographic information, there will be benefits in a much broader arena.

KEY WORDS: Standards, Cartography

NECESSITY OF DATA INTERCHANGE STANDARDS

The need to transfer spatial data between noncommunicating systems is becoming increasingly important. The concerns for common data formats and geocoding conventions cut across all topics of spatial data handling. Currently, it is difficult and inefficient for diverse users to use a given set of data. At least five major forces are causing concern about incompatibility: (1) increasing amounts of spatial data are being generated and must be stored, cataloged, and retrieved, (2) there is rapid progress and expansion in the area of spatial data processing, (3) increasing amounts of related and useful data are being obtained in digital form, (4) increasing sophistication in the ability to register digital images with maps and to analyze multiple sets of data is resulting in a call for more digital data, and (5) much of the map automation effort may be duplicative and redundant (Digital Cartographic Data Standards [DCDS] Task Force, 1988).

A spatial transfer standard offers several advantages to users of spatial information: (1) it provides a systematic and comprehensive set of primitive and simple cartographic objects from which digital cartographic feature representations can be built, (2) it allows the transfer of digital spatial information between noncompatible systems while preserving the meaning of the information, (3) it supplies data quality information to users in order to evaluate the fitness of data for a particular use, (4) it offers the opportunity to share project costs by sharing data, (5) it results in lower overall cost for obtaining data and maintaining redundant data, and (6) it supports efforts to update data using multiple sources.

Both the Federal Government and the academic community have been working for the last few years to develop a spatial data transfer standard that includes definitions of terminology, a spatial data transfer specification, recommendations on reporting digital cartographic data quality, and topographic and hydrographic entity terms and definitions. Having such a standard in place will be a great benefit to the users of digital spatial data.

SPATIAL DATA TRANSFER STANDARD

History

In 1980, the U.S. National Bureau of Standards (now the U.S. National Institute of Standards and Technology) signed a memorandum of understanding with the U.S. Geological Survey that resulted in the Survey assuming the leadership in developing, defining, and maintaining earth science data elements and their representation standards for use in U.S. Federal Government agencies.

In 1982, a national committee composed of members from private industry, government, and academia began work on a digital cartographic data standard. This committee was formed under the auspices of the American Congress on Surveying and Mapping and was supported by a grant from the Geological Survey. Professor Harold Moellering of The Ohio State University headed the committee, which produced nine reports. Report 8, "A Draft Proposed Standard for Digital Cartographic Data," summarized the committee's activities and work. In 1983, the Office of Management and Budget issued

a memorandum establishing the Federal Interagency Coordinating Committee on Digital Cartography (FICCDC) and naming the Department of the Interior as chair, which was delegated to the U.S. Geological Survey. The purpose of the FICCDC is to coordinate the digital cartographic activities of Federal agencies and through this process avoid duplication in the development of digital cartographic data bases. Another duty of the committee is to develop and adopt, for use by all Federal agencies, common standards of content, format, and accuracy for digital cartographic data to increase their interchangeability and enhance their potential for multipurpose uses. The standards working group of the FICCDC selected as a priority task the development of a data exchange format and published a report titled "Federal Geographic Exchange Format."

In March 1987, the Geological Survey established a task force to combine the proposed cartographic data standard with the geographic exchange format. This combined document, "The Proposed Standard for Digital Cartographic Data," was published as the January 1988 issue of *The American Cartographer*.

The responsibility for finalizing the standard rests with the Geological Survey. A maintenance authority within the National Mapping Division was established in 1988 to test the proposed standard, conduct educational workshops, disseminate information, and in general coordinate activities surrounding the promotion of the standard to the National Institute of Standards and Technology (NIST) as a Federal Information Processing Standard (FIPS). A Technical Review Board, consisting of technical experts from the Federal Government, the private sector, and the university community was established to oversee the content of the standard as it was finalized and prepared for submission to the NIST. This Board is composed of experts who represent a diversity of viewpoints in the collection and use of digital spatial data.

Objectives

As stated in the DCDS Task Force report (1988), the objectives of the standard are:

"1. to provide a mechanism for the transfer of digital spatial information between noncommunicating parties using dissimilar computer systems, preserving the meaning of the information, and reducing to a minimum the need for information external to this standard concerning the transfer.

2. to provide, for the purpose of transfer, a set of clearly specified spatial objects and relationships that can represent real world spatial entities, and to specify the ancillary information that may be necessary to accomplish the transfers required by the cartographic community.

3. to provide a transfer model that will facilitate the conversion of user-oriented objects, relationships and information into the set of objects, relationships and information specified by this standard for the purposes of transfer such that their meaning will be preserved and can be discerned by the recipient of a conforming transfer.

4. to insure that any implementation of this standard can have the following characteristics:

   a. the ability to transfer vector, raster, grid, and attribute data, and other ancillary information.

   b. the implementation methodology can be media-independent and extendable to encompass new spatial information as needed.

   c. an internally contained description of the data types, formats, and data structures such that the information items can be identified and processed into the user's native system.

   d. the data and media formats should be based where practical on existing FIPS, ANSI, ISO, or other accepted standards."

The Spatial Data Transfer Specification is the method whereby spatial data from one data handling system can be easily transferred to another data handling system. The standard provides a modular specification of data types and formats for the full set of digital information to be transferred. Of necessity, the transfer specification is complex because it must handle both vector and raster data.

Content

The proposed standard (SDTS Technical Review Board, 1990) consists of three parts. Part 1, Logical Specifications, includes a conceptual model of spatial data and definitions of fundamental cartographic objects and key terms that serve as conceptual building blocks for the constructs presented in the standard; a transfer specification, defining the logical file structure for the transfer of the data; and data quality requirements that specify the form of the quality report and require the data provider to supply detailed information about the data set being transferred in order for the user to evaluate the fitness of that data for a particular use. The Logical Specification component defines a set of primitive and simple cartographic objects in zero, one, and two dimensions with which digital cartographic feature representations can be built. Definitions are also presented for key conceptual terms that are used throughout the standard. The basic concept underlying the Data Quality component is a "truth in labeling" concept. The standard requires a report of what is known about the quality of the included data. Five components are available under which to define data quality: lineage, positional accuracy, attribute accuracy, logical consistency, and completeness.

Part 2, Spatial Features, presents a domain of cartographic entities and attributes with standard definitions, and a list of included terms to facilitate cross referencing from user feature categories to standard categories. The Spatial Features component provides a model and definitions for cartographic features. The model consists of entities, attributes, and attribute values. A list of topographic and hydrographic entities and attributes is provided with the standard; however, the standard also provides a mechanism for user-supplied definitions to accompany the data transfer.

Part 3, the ISO Implementation, uses the existing international standard, "Information Processing Specification for a Data Descriptive File for Information Interchange," as the implementation mechanism for physical encoding of SDTS data.

Status

The standard was tested in two phases between January 1988 and April 1989. The purpose of Phase 1 testing was to test the conceptual framework and implementation of the SDTS, and prove that data could be encoded and decoded into and out of the Standard. Phase 1 testing involved organizations from the Federal government that had been closely associated with the development of the SDTS: the U.S. Geological Survey, the Bureau of the Census, and the Defense Mapping Agency. Each of these organizations completed test data sets. The U.S. Geological Survey encoded a Digital Line Graph file, the Bureau of the Census, a TIGER file, and the Defense

Mapping Agency, a World Vector Shoreline file. These files were exchanged and decoded by each participating agency. Errors and suggested improvements resulting from this exercise were documented and presented to the Technical Review Board. The board reviewed and voted to accept 14 of 17 proposed changes. These changes were incorporated in the standard and a revised version, "The Proposed Standard for Digital Cartographic Data" (DCDS Task Force, 1988), was prepared for the phase 2 testing period.

Phase 2 testing began in September 1988. The purpose of this second testing phase was to open up participation in this activity to include other Federal agencies, the private sector, and the university community. Three workshops were held to initiate participants in the background, purpose, goals, and content of the standard. Over 60 individuals from more than 20 private firms, government agencies, and universities attended. Participants were presented with several options for testing the concepts presented in the standard ranging from completing a paper and pencil conceptual mapping between one data format and SDTS to completing a full transfer of data between two organizations. Testers were required to document and report their findings. As a result of this testing, 124 suggestions were submitted to the Technical Review Board. Participants expressed major concerns about the amount of complexity and optionality contained in the standard and offered suggestions to clarify specific points.

The Technical Review Board met in May 1989 to consider the issues raised as a result of phase 2 testing. At this meeting discussions were held on terminology, data models, data transfer forms (vector, relational, and raster), map annotation, symbology, and ISO 8211 as the transfer implementation method. Highlights of the changes proposed at this meeting include:

- Change the official name of the standard from the "Digital Cartographic Data Standard" to the "Spatial Data Transfer Standard."

- Establish a working group to define a conceptual model of spatial data that reflects what is described in the standard and to develop a more complete description of terminology, including standard objects and their relationships.

- Establish a working group to consolidate the vector and relational form. Relocate modules of the relational form associated with attributes into the vector form. Delete the hierarchical method used to code attributes within the vector form and all modules in the relational form not associated with attribution.

- Solicit input from users of raster data in the community through a letter asking for review of the raster form as it is currently written. Additional information is needed because the raster form has not received as extensive testing as the vector form.

- Rework the standard in order to comply with requirements of NIST and to simplify the documentation by restructuring the format and renumbering.

Completion of the above tasks and consideration of the remaining recommendations received from phase 2 testing required significant revision of the standard. The Board recognized that in order to make these major modifications, submission of the standard to the NIST had to be delayed; however, the rework was deemed necessary and worthwhile in the long term. The changes simplify the documentation, decoding tasks, and encoding of attributes, and create a more understandable and usable document. Based on peer reviews, additional simplification measures were undertaken by the Technical Review Board.

The Board met again in July 1989 to review progress of the working groups established in May and to discuss remaining issues. One outstanding issue considered was that of conformance. The Board established a working group to review this topic and determine conformance statements that should be included in SDTS. A representative from the NIST is assisting in this effort.

A meeting of the Board in December 1989 resolved most of the outstanding issues of content. Editorial revisions prior to final reformatting and renumbering was the primary agenda item when the Board met again in March 1990; and identification and correction of ambiguities, discontinuities, and misstatements was undertaken at the final meeting of the Board in May 1990. The standard was finalized and submitted to the NIST in summer 1990.

The National Institute of Standards and Technology provided technical assistance to support the final phase of preparing the proposed standard for FIPS processing. Support was provided in evaluating the standard in terms of FIPS standards and guidelines for data administration, data base management, graphics, and related items; in preparing a strategy for successful finalization of the standard, including the identification of potential problems and issues and recommendations for resolving them; and in initiating the planning, development, and implementation of a conformance testing program for the standard. This coordination was undertaken to ensure that potential problems were identified before the standard was finalized, in order to avoid extended delays and rework during the FIPS approval process.

To make the standards development process an open process, NIST follows rulemaking procedures modeled after those established by the Administrative Procedures Act. When technical development of a standard is complete or stable enough to allow for commercial implementation, NIST prepares a Federal Register notice announcing the proposed FIPS for public review and comment. The Federal Register notice and proposed FIPS are reviewed by the Department of Commerce (DoC) and the Office of Management and Budget (OMB) prior to publication in the Federal Register.

A 90-day period is provided for review and submission of comments on the proposed FIPS. At the same time that the proposed FIPS is announced in the Federal Register, NIST sends the proposed standard to senior contacts in Federal Government agencies and departments, and in State agencies. Comments received in response to the Federal Register notice and to the notice to Federal and State government agencies are acknowledged and reviewed by NIST. Copies of comments received are sent to the DoC Central Reference and Records Inspection Facility for public inspection.

After the 90-day review cycle, a detailed justification document is prepared analyzing all of the comments received and explaining whether modifications were made or why recommended changes were not made. The text of the final FIPS, the detailed justification document, the comments received, the analysis of comments received, and other supporting material related to the FIPS are reviewed by the NIST staff, the DoC, and the OMB prior to submission to the Secretary of Commerce for approval of the FIPS.

Finally, a notice announcing approval of the FIPS from the Secretary of Commerce is published in the Federal Register. A copy of the detailed justification document is forwarded to the Central Reference and Records Inspection Facility and

Federal and State agencies are notified of the approval of the FIPS.

The current role of the Geological Survey is to provide support to NIST during the comment and revision period and to develop user documentation and software support. Following approval as a FIPS, the Geological Survey is prepared to submit this standard to the American National Standards Institute, Inc., for promotion as an ANSI standard.

Utility

User Interface. Users are a vital part of this development effort. The latest improvements to the standard were initiated in part because of concerns about the difficulty of using and promoting a complex standard. The Survey recognizes that a significant effort must be undertaken to develop software interface tools and documentation so that the detailed constructs in the standard will be transparent to the user.

The vendor community must also take an active role in developing software tools to encode and decode spatial data between the standard format and their own system format. A concerted effort has been made during the development of the standard to keep the private sector informed and to use their input to improve the standard. With the cooperation and support of Federal agencies and the private sector, the transition of converting to this standard can be made smoothly and effectively.

National Digital Spatial Data Base System. Within the government, developing and using existing digital cartographic data bases is becoming very popular. The absence of uniform standards for the transfer of digital spatial data is hindering the exchange of data and increasing costs. From a Federal agency perspective, the utility of the Spatial Data Transfer Standard is enormous. With such a standard in place, a large distributed spatial data base system within the Federal Government will be possible. A National Digital Spatial Data Base System is a proposed network of independently held and maintained Federal digital spatial data bases (Federal Interagency Coordinating Committee on Digital Cartography Standards Working Group, 1989). Traditional cartographic categories such as hydrography, boundaries, transportation, and elevations would be held, along with thematic categories such as soils, wetlands, geology, vegetation, and demography. The objectives of this national data base system are to:

- encourage and hasten the use of the Spatial Data Transfer Standard
- provide a mechanism for improved coordination and standardization of data content and quality
- provide for more consistent and compatible Federal spatial data bases
- improve the efficiency and effectiveness of Federal agencies and others using Federal spatial data bases
- inform users and potential users of digital spatial data regarding availability and data content
- clarify Federal agency responsibilities for developing, maintaining, and distributing spatial data bases

Such a system will require that each agency responsible for spatial information about the United States be able to release its information in the standard SDTS format. The updating and accuracy of a data set would remain the responsibility of the agency that has the mandated responsibility to collect and use that data set. The National Mapping Division of the Geological Survey will establish base data categories, such as hypsography, hydrography, transportation, and boundaries, in data files that will be obtained by the general public through the standard format. It is envisioned that other agencies will make their data available in a similar manner so that a user could acquire those data files and overlay them on Geological Survey base data without knowledge of the internal formats used by the collecting agencies. Using the standard for release of data allows each agency to design and use its own internal format to process spatial data and does not require standardization across the Federal Government on one data structure, data format, and hardware/software system.

CONCLUSION

It is clear that the time for spatial data standards is here. The availability of standards has many advantages to the data collector, processor, and user, particularly those who need to utilize data from several sources. The establishment of standard terminology will be of great benefit in setting a common language of definitions for users and producers of spatial data. A standard transfer specification will facilitate the exchange of spatial data throughout the public and private communities and will enhance the capability for displaying and analyzing and integrating spatial data for a growing number of applications. The availability of information about data quality, such as lineage, completeness, accuracy, and logical consistency, will help users to evaluate the fitness of the data for a particular use. The Spatial Data Transfer Standard provides these characteristics and offers a mechanism for the exchange of spatial data that is long overdue.

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THE PURPOSES OF COS GRAPHICS IN LAND USE PLANNING EFFORTS - GRAPHICS RIGHT FROM THE START OF THE PROJECT

BY JACK SHEFFEY, BLM, UTAH STATE OFFICE

THE CARTOGRAPHIC OUTPUT SYSTEM (COS) SHOULD NOT BE VIEWED AS BEING CAPABLE OF ONLY FINAL MAP PRODUCTION. QUITE THE CONTRARY - WHILE COS CAN PRODUCE VERY ATTRACTIVE, INFORMATIVE AND PROFESSIONAL FINAL QUALITY MAPS - COS CAN BE EXTREMELY EFFECTIVE RIGHT FROM THE START OF A PROJECT, AND THROUGHOUT THE ENTIRE LIFE OF A PROJECT.

COS GRAPHICS FALL INTO SIX PRIMARY CATEGORIES:

1. DATA VERIFICATION - GOAL NUMBER 1 - WE MUST ASSURE THE INTEGRITY OF OUR DATABASE. IN ADDITION TO 7.5' VERIFICATION PLOTS AND SCREEN DISPLAY, COS MAPS PORTRAYING RESOURCES ON AN ADMINISTRATIVE WIDE BASIS ARE CRITICAL TO BE CERTAIN THAT WHAT WAS DIGITIZED IS BOTH CORRECT AND COMPLETE.

2. RESOURCE IDENTIFICATION - COS MAPS TO ASSIST THE MANAGERS AND RESOURCE STAFF BECOME FAMILIAR WITH ALL RESOURCES.

3. PORTRAY MANAGEMENT PRIORITY AREAS - COS MAPS SHOWING AREAS OF HIGHEST RESOURCE VALUES - THE BEGINNING OF THE DECISION MAKING PROCESS.

4. PORTRAY POTENTIAL CONFLICTS - COS MAPS TO ASSIST THE CONFLICT IDENTIFICATION/CONFLICT RESOLUTION PROCESSES.

5. PORTRAY PROPOSED MANAGEMENT ACTIONS (DECISIONS) - IDENTIFY THE ALTERNATIVES FOR MANAGEMENT - COS MAPS GIVE A CLEAR PICTURE OF EXACTLY WHAT IS BEING PROPOSED - AND CAN BE MODIFIED AND/OR UPDATED IN A VERY EFFICIENT MANNER.

6. FLIPCHARTS AND TITLE PAGES - FRINGE BENEFITS OF COS DRESS UP PRESENTATIONS AND PUBLIC MEETINGS ADD A VERY PROFESSIONAL TOUCH

*** THE PROJECT AND DECISIONS WILL REVOLVE AROUND THE MAPS! ***

UTILIZING THE FOUR PART COS PROCEDURE, FIELD OFFICES CAN ACQUIRE THE ABILITY TO PRODUCE THEIR OWN MAPS AND GRAPHICS, AND CAN EASILY MAKE ADDITIONAL COPIES FOR REVIEW AND DISPLAY AT PUBLIC MEETINGS.

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USING COS TO IMPROVE THE EFFICIENCY OF GIS-ASSISTED RMP's/EIS's

The Cartographic Output System (COS) is the subsystem of the MOSS family of GIS software from which published quality maps can be produced. COS has been used very effectively for several RMP/EIS projects throughout the Bureau, and is especially well suited for larger projects that produce many very similar maps.

A procedure has been developed which, through coordination with the State Office, allows the field office to produce final quality maps portraying resources and proposed management actions, utilizing COS. Implementing this procedure in association with an RMP or EIS can significantly improve both the productivity and efficiency of those involved in the project.

Placing this capability at the field office level presents several advantages.

1. Resource Specialists can prepare final quality maps of every resource, with little assistance, early in the life of the project. Additional copies can be made for review by other resource specialists and for display in public meetings. The resource specialist can prepare and verify the correctness of each map in the field, then inform the State Office that the map is ready. This can save a great deal of coordination time.

2. Having all resources portrayed early in the life of the project greatly assists the project team in identifying resource conflicts, determining conflict resolution measures, and minimizing the possibility of a significant resource or conflict being overlooked. These maps also provide a vehicle for effective communication between the project team and management.

Maps can be produced for any geographical area, and at any scale, in the form of page size or presentation size, in color or black and white.

When the document is being prepared for printing the procedure can save a very significant amount of time by relieving the State Office Section of Cartography of a large portion of the map preparation time by building this capability into the field office in association with other project requirements. The procedure includes the following steps:

1. **Prepare Base Map**

Utilizing COS, a base map is prepared for a defined geographical area (i.e., Resource Area/District boundary or other administrative unit). The base map will include all base reference information common to all project maps, such as the Planning Area Boundary, Township and Range, transportation network, cities, streams and rivers, bar scale, north arrow, general location map, Bureau/Department symbols, and all associated text. (See Fig. No. 1

The base map must be prepared by a State Office cartographer with COS training. Typically one week of COS training is adequate (for an individual

with MOSS experience) to understand COS and be able to comprehend base map preparation. A base map can usually be completed within 2 to 3 days by an individual utilizing COS, and needs to be done just once for the entire project.

The base map is then used as a template from which a copy is made and the thematic information, title, and legend are added.

2. Prepare "Generic" Thematic Map

A "generic" thematic map is prepared which includes the Planning Area Boundary, generic legend boxes, and generic starting location for legend text and map title. (See Fig. No. 2.)

This step is also prepared by a State Office Cartographer. The generic thematic map is used as a template, which is copied and used to create the actual resource thematic map, map title, and legend. This step requires relatively little time, in just a few hours, and needs to be done only once for the project. Mapping standards adherence with respect to title and legend location, character style, and size are assured by the cartographer preparing the generic thematic map.

3. Create Thematic Map

Creation of the thematic map, title, and legend. After the generic thematic map is copied, the resource thematic information is added. This step is accomplished by the field office resource specialist/RMP team member. This requires 3 to 4 days of COS procedure training. Training includes guidelines for line styles, symbology, and shading patterns to assure maps will meet Bureau mapping standards. Any line style, color, and shade patterns can be used. Differences within the resource can be readily distinguished (I.E., elk winter range vs. elk summer range, vs. elk calving grounds) by using a different color or shade pattern. (See Fig No. 3)

4. Create Final Thematic Map

The thematic map is combined with the base map to produce a published quality final thematic map which can be plotted and verified correct in the field office. This step is also carried out by the field office and requires only 1 to 2 hours per map. Maps can easily be custom tailored to meet particular needs. See Fig No. 4)

This procedure has been used very successfully to accomplish Utah's San Rafael RMP which has had 14 large pocket maps (5 color and 9 black and white), 102 black and white page size, and 75 color page size maps produced for the MSA, draft and final documents, plus a considerable number of maps for display/review purposes only.

The same procedure is utilized when the State Office Section of Cartography prepares the final maps for printing by producing negatives from which printer plates are made.

Implementing this procedure and involving State Office cartographers at the outset can result in a substantial improvement in the productivity, efficiency, and success of the project.

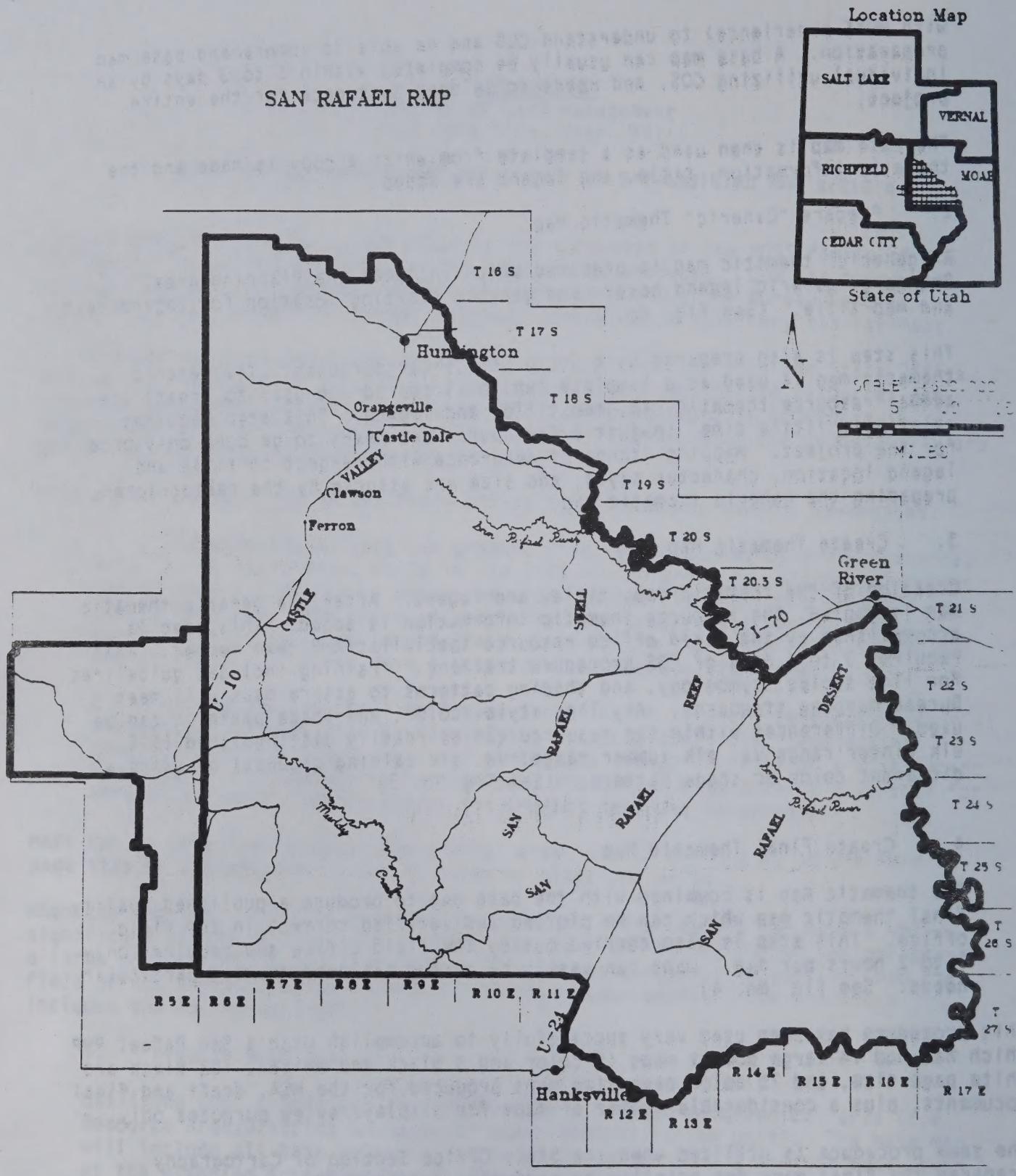


FIGURE 1 BASE MAP

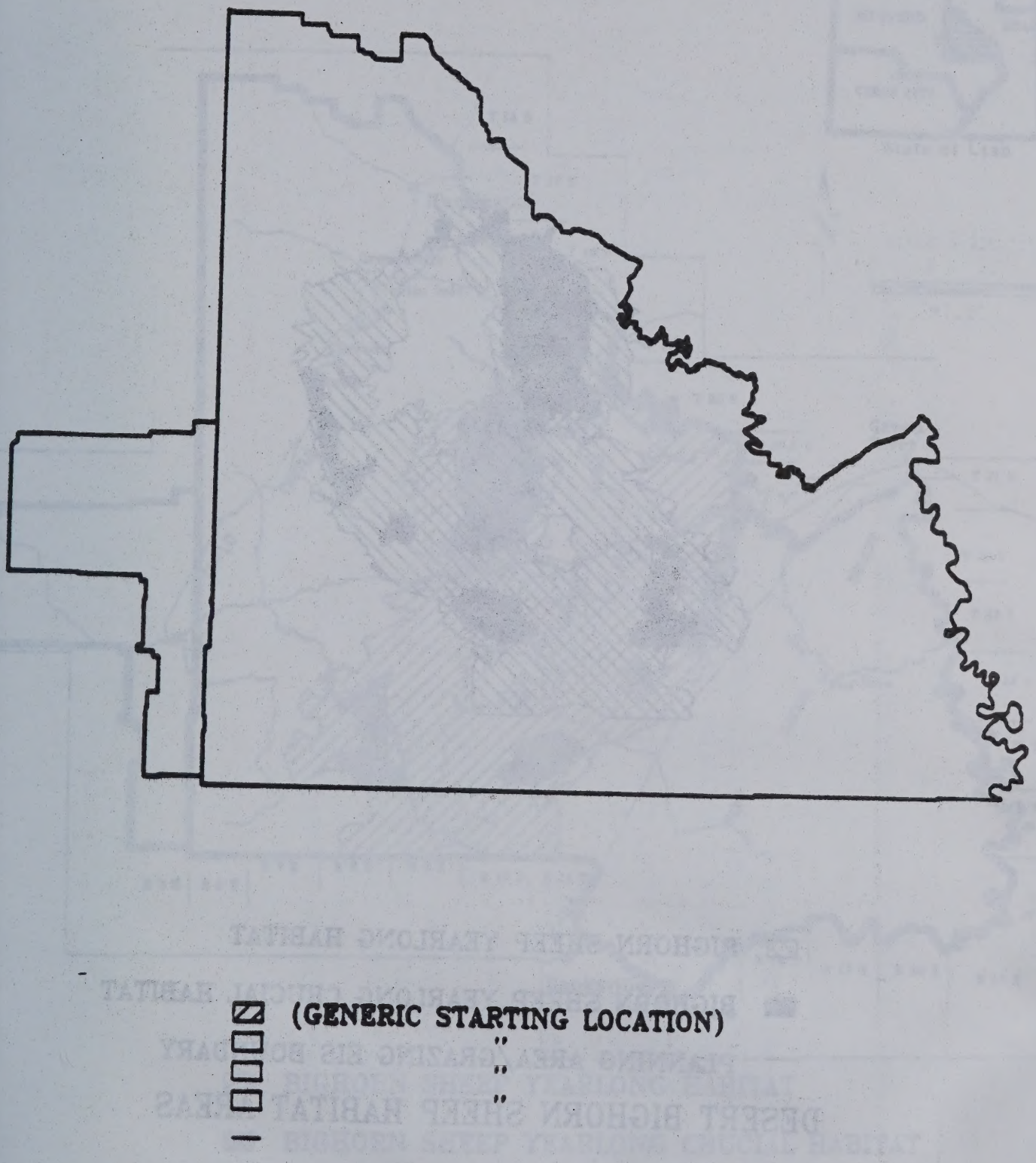


FIGURE 2 GENERIC THEMATIC MAP

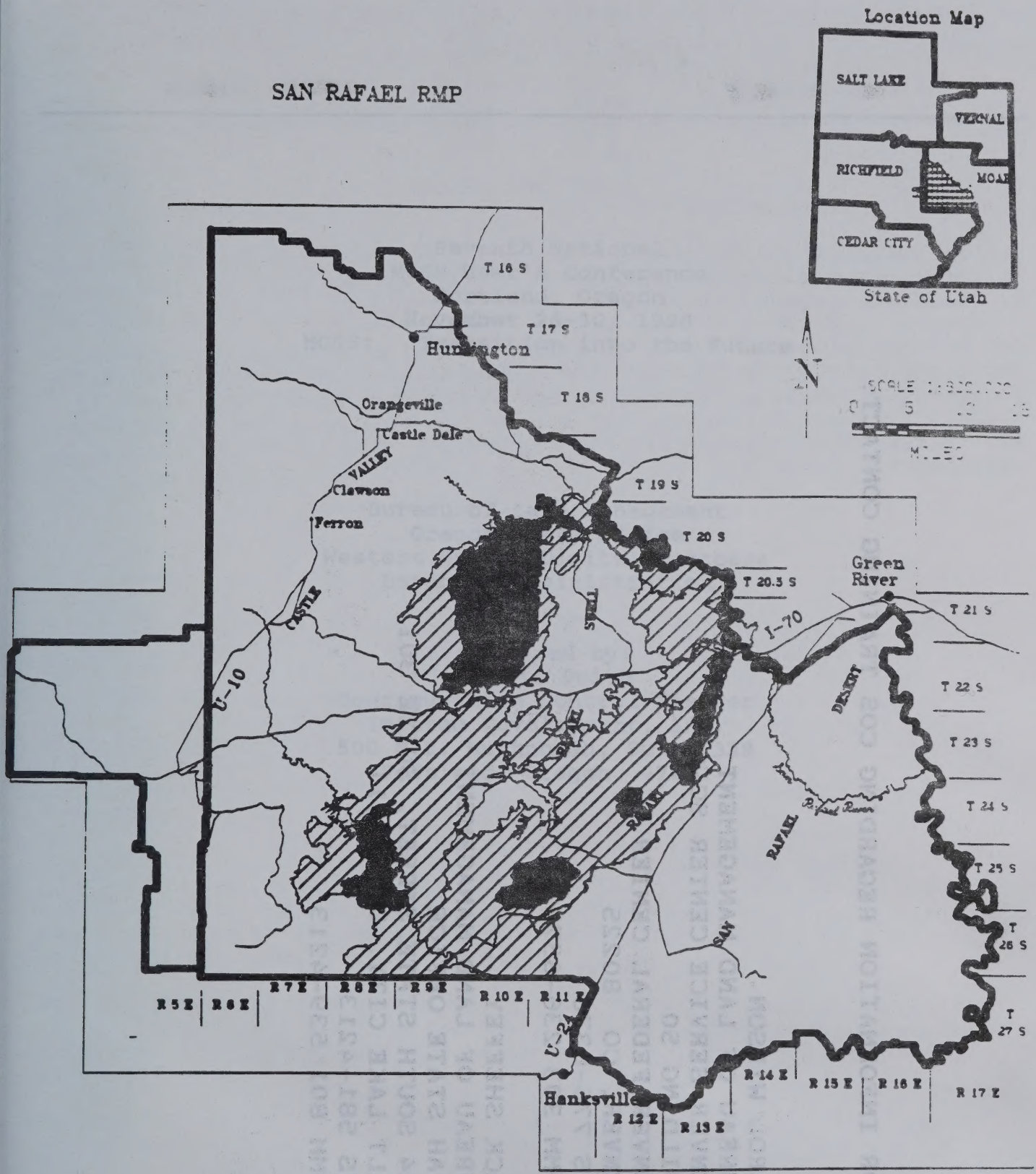
▨ BIGHORN SHEEP YEARLONG HABITAT

■ BIGHORN SHEEP YEARLONG CRUCIAL HABITAT

— PLANNING AREA/GRAZING EIS BOUNDARY

DESERT BIGHORN SHEEP HABITAT AREAS

FIGURE 3 THEMATIC MAP



DESERT BIGHORN SHEEP HABITAT AREAS

FIGURE 4 FINAL THEMATIC MAP

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Seventh National
MOSS User's Conference
Portland, Oregon
November 26-30, 1990
MOSS: Transition into the Future

Bureau of Land Management
Oregon State Office
Western Oregon Digital Database
Database Administration

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ABOUT THE AUTHOR

Debbie Smith joined Infotec Development, Inc. in December of 1989 as Configuration Control Manager in the Bureau of Land Management in the Oregon State Office.

She brought with her nearly 15 years of data processing experience. Her accumulated experience includes database administration, systems programming, disk management, system software support, and security administration. Throughout her career she has continued to develop her skills with formal training, self-study, and actual on-the-job experience.

Introduction to Configuration Control Management

The CCM group was created to receive materials for Production processing in the Oregon State Office from the District offices, and return the finished materials to the District. CCM contributed to the tracking effort of the themes throughout the Production process.

The CCM group currently serves the BLM Oregon State Office and the District Offices in Coos Bay, Salem, Roseburg, Eugene and Medford.

CCM's areas of support have been expanded to include Database Administration, Data Management and the Oracle Relational Database Management Systems.

DATABASE ADMINISTRATION

.WODDB - Development Environment.

Development of the Western Oregon Digital Database began several years ago with the data collection effort by the District Offices. The District Offices submitted the data to the Oregon State Office for Production processing. Production procedures were developed to support the translation of the various kinds of input data into MOSS format.

The District Offices formed Team D to establish guidelines for development of the WODDB database.

The Production procedures were reviewed recently and updated to provide the necessary support for transition from the development database environment to future database requirements. Controls are being established to assure the integrity and security of this valuable data asset.

We identified and designated which MOSS Projects contain Master Data in the Oregon State Office and the District Offices. All Master ADS data used in the MOSS edit function resides on tape in the Oregon State Office.

The Configuration Control Management group was designated as the master data control point. A check-out procedure was defined to track and control ADS edits to master data. Manual checks are performed to assure the data is not already checked out for edit. The data is then moved by CCM to a designated work area for the edit. A check-in process was defined to assure the edited Master ADS data is saved to tape at the same time the MOSS data is transferred to the Master MOSS Project.

Security access controls were set to assure check-out and check-in can only occur through CCM to promote the effectiveness of these standard procedures.

At this time the Master Data designation is being expanded to include the formatted ASCII file input from the District Offices used in creation of the MOSS multiple attribute file. The goal is to assure the input file, used in the DBLINK process to link the MOSS map and its attribute file, is saved at the same time updates are made to the Master MOSS project.

During the initial development of the database all maps were produced at the individual township level. As the project grew the number of map files grew. Projects to re-structure the data into Quad and District wide scales were initiated to attempt to reduce the ever growing number of files.

Experience with the development database structure was an important element in determining the structure of the operational database.

The database development effort continued until selected themes were ready for use in the Resource Management Plan. Software development has begun in the Oregon State Office based on District Office requirements. The software interfaces with MOSS and Oracle to produce the desired deliverable files.

.WOODB - Operational Environment.

The WODDB database will provide the foundation for building the operational database for many themes.

Planning and preparation for the operational environment began some time ago.

The Districts determined the beginning of the operational database would be the FOI/TRN theme updates to the base development data. A team was formed from the District Offices, the Oregon State Office and IDI staff to work toward that end.

The District Offices expressed the need for formation of a Team O to look at the operational database. Their charter would be to establish guidelines for development of resource themes that would be necessary to support operational requirements of the project.

.DATA MANAGEMENT.

Management of a database relies on the support of many other components of the data processing environment for success. Data Management projects were initiated to enhance those components that were put in place during the development phase. Additionally, many new components were necessary to support the future environment.

Let's look briefly at some of the Data Management projects:

.Capacity Planning studies are needed to determine what computing resources are available statewide. A high level evaluation of resident resources required for system functions gives us an estimate of the available resources for processing work. We need to have a good idea of the computing power and disk space available to assist in project planning for the multitude of emerging tasks.

.We have begun to develop effective Disk Management techniques and utilities for ongoing support. This will include practicing good housekeeping to assure only required data is on the system at any given time. We need to evaluate data placement to assure optimum online response and batch process turnaround.

.File management of files other than the database became an issue. An example would be interim and final files created during the management planning processes. There is a need to archive them from the system as soon as as possible during processing to free space for other work. These files need to be stored indefinitely for historical purposes. Archive Data Management procedure and catalog system was created to resolve increasing problems with ever-expanding space requirements.

.The Oregon State Office and the District Offices had established System Software & Hardware procedures to promote system portability. We have begun to enhance these procedures from a statewide perspective to ensure continued portability throughout the logical computing resource.

.Application Software Management became important as we began to develop software for management planning efforts. We defined a test and production environment to provide consistently reliable systems. Guidelines were set for software development that included various walk-through and approval stages with BLM and IDI.

.A tape management system was designed and later enhanced to include an Oracle interface to assist in management of the great volumes of Master ADS data tapes.

.Effective backups of system and application data were developed in the Oregon State Office and the District Offices. We began to enhance these procedures with new requirements such as Oracle database backups for archive and recovery capabilities.

.Existing Standard Operations Procedures developed in the Oregon State Office and the District Offices are being reformatted and reviewed to satisfy new data processing requirements. A Standards & Procedures manual has been introduced to document and communicate data processing procedures outside data center operations.

.ORACLE RELATIONAL DATABASE MANAGEMENT SYSTEMS.

Oracle was introduced to the project by implementing separate systems at the Oregon State Office and each of the District Offices. All of the systems are running identical versions and data is easily ported between them.

Thus far, Oracle has primarily been used in the District management planning effort through software developed to track file processing and produce deliverable results.

Formal training was scheduled to enhance our application development and database administration abilities. This proved valuable to us in optimizing our batch processing with SQL and tuning the Oracle database.

Oracle Standards & Procedures were created to ensure system reliability and recovery capabilities. This included regular magnetic tape backups and database file dumps to provide flexible recovery and archive capabilities.

Guidelines are being established for software that interfaces with Oracle to support the processing effort based on past experience. An example would be development of standard scripts to manage the Oracle tables and calculated space definitions.

FUTURE PROJECT CHALLENGES

.Operational WOODB
As the District Offices begin their Operational database effort in the near future we will be able to provide reliable database support with the procedures initiated during the development phase of the project. The BLM and IDI team continue to prepare for the initial FOI/TRN theme update in the operational environment.

.Development has begun on a Master Map Control System to manage the maps and automate many of the control functions that will initially be performed manually in the operational environment.

.ORACLE
We will be testing SQL*NET, an Oracle software, to consolidate the Oregon State Office and District Offices' separate systems into one logical database. We will actively use Oracle in the BLM District Resource Management Plan software interface with MOSS.

Upon completion by the Denver Service Center, the MOSS/Oracle Bridge will be evaluated for use in maintaining MOSS multiple attribute files.

.Resource Management Plan Processing
We will be supporting the Alternative B through E effort in the Resource Management Plan to fulfill District Office requirements in the near future. Software development and planning is already underway.

.Data Management
We will continue to develop and refine the components of data processing necessary to support the project. Some of these were mentioned briefly. Many of our procedures are initially a manual effort and will ultimately be automated.

.Project Communication
Open communication during this rapidly evolving phase of the project is critical to future success. The BLM/IDI team in the Oregon State Office has succeeded in improving communication in all areas, and we are striving to expand that to the rest of the team in the District Offices.

Hypothetically speaking, if the District is performing operational online updates in MOSS, they have scheduled Online MOSS training, the Oregon State Office is processing their planning software in batch with an Oracle interface...all simultaneously...there is bound to be contention for computing resources.

Database Administration Prepared by: Debbie Smith/Infotec

Planning and scheduling the logical computing resource to fulfill the objectives of the Bureau of Land Management will be one of our major challenges.

We will be introducing an online NEWS facility in the near future to communicate to all members of the project team the tentative processing activity throughout the state.

Contained in the NEWS will be a weekly schedule of the upcoming processing activities and scheduled system maintenance events. The schedule will be a combined effort of the Oregon State Office and the District Offices.

My involvement with this project has been challenging, rewarding, enlightening and, at times, overwhelming.

I am inspired by the genuine effort of the people I have worked with in the Oregon State Office, the District Offices and the IDI staff in making this project a success.

I am glad to be a part of the team.

ARTIFICIAL INTELLIGENCE
- Just Another Tool for Natural Resource Management

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As a public agency we must take responsibility for our information and that includes management, administration and representation. Artificial Intelligence is just another advanced technical tool that can integrate with other tools such as MOSS to provide natural resource managers integrated information for Forest Plan implementation and monitoring.

AI was coined in 1956 when a group of computer scientists met at Dartmouth College to discuss the potential of computers for simulating human intelligence. AI is a young, underdeveloped discipline in the natural resource community. It is developing rapidly since it's tentative beginnings in the early 80's.

Artificial Intelligence, commmonly referred to as AI, is a subdivision of computer science devoted to creating computer software and hardware that imitates the human mind. It deals with the representation, automatic acquisition, and use of knowledge. AI programs attempt to emulate human thought processes such as deduction, inference, language, and visual recognition. A potentially powerful tool to assist us in our work.

Computers can perform mathematical calculations, manipulate numbers and letters, make simple decisions, and perform various storage and retrieval functions. In these applications the computer is exceptional and usually exceeds the human mind in performance. AI gives computers added computing capability. Development of AI applications involves the integration of advanced computer science, psychology and sometimes robotics.

Intelligence, the ability of a human being to acquire knowledge and apply it, means the capability of thinking and reasoning. To a limited degree, artificial intelligence permits computers to accept knowledge from human input then use that knowledge through simulated thought and reasoning processes to solve problems. The knowledge a computer can acquire consists of facts, concepts, theories, procedures and relationships. The grouping of this acquired knowledge for a chosen domain (domain = sphere of interest), is in the knowledge base.

The knowledge base forms the system's source of intelligence and will be used by an inference mechanism to reason and draw conclusions. The inference mechanism is a set of procedures that are used to examine the knowledge base in an orderly manner to answer questions, solve problems, or make decisions within the domain. The computer's knowledge base and inferencing capability augment those of the user.

The major subfields of AI include general problem solving, expert systems, natural language processing, computer vision and pattern recognition, robotics and neural networks. All employ a knowledge base and inferencing techniques to solve problems or help support decisions. Of these subfields, the one of most immediate interest to natural resource managers is expert systems.

In conventional software, we tell computers how to solve the problem where as in AI we tell the computer what the problem is but not how to solve it. Conventional computer programs are based on an algorithm, a clearly defined, step-by-step procedure for solving a problem. It may be a mathematical formula or a sequential procedure that uses data such as numbers, letters, or words to solve the problem.

Artificial Intelligence is not based on an algorithmic process. Instead it is based on symbolic representation and manipulation. In AI a symbol is a letter, word, or number that is used to represent objects, processes, and their relationships. Objects can be people, ideas, things, concepts, events or statements of fact. By using these symbols, it is possible to create a knowledge base that states facts, concepts and the relationships between them. Then various processes are used to manipulate the symbols to solve a problem. The process is qualitative rather than quantitative. AI software searches the knowledge base looking for specific conditions or patterns. Looking for matchups that satisfy the criteria set up to solve the problem.

An expert system permits the knowledge and experience of one or more experts to be captured and stored in a computer. This knowledge can then be used by anyone requiring it. The purpose of an expert system is not to replace the human expert but merely make their knowledge and experience more widely available. Knowledge is a valuable resource. Experts take vacation, retire, get sick, move on to other fields, die and otherwise become unavailable. Books can capture some knowledge but they leave the problem of application up to the reader. Expert systems provide a direct means of applying expertise.

Informal acquisition of knowledge, like how to ride a bike or bake breads, is the way people have learned the knowledge that sets them a part as experts, not from classroom lessons but from interacting with knowledgeable people in information rich settings. Experts tend to underestimate both how much they may know and how long and complicated the task of capturing their knowledge will be. One of the most difficult parts of expert system construction is the acquisition of the appropriate knowledge. It can be an intimidating and awkward experience for people.

People can be specially trained in the skills of interviewing and expert system design. They are called knowledge engineers and possess the skills necessary to identify suitable domains and experts, extract the knowledge from these experts, and build an expert system to mimic the experts decision process. Psychologists and human factor specialists have played an important role in developing methods used in these interview processes. There are relatively few of these highly trained individuals in the natural resource arena.

An Expert System contains a knowledge base, data base, and a user interface. The knowledge base contains domain specific facts and rules that previously have been defined by one or more domain experts. These facts and rules are encoded in symbolic form usually in the form of if-then clauses called

production rules. They are extremely flexible and easy to update. The first part of the rule (IF) states some premise, condition or antecedent. This is the left-hand side of the rule.

Example: IF THE ANIMAL LIVES IN THE WATER
AND THE ANIMAL HAS GILLS AND SCALES

The right-hand side (THEN) states a conclusion, action or consequence that will take place if the conditions on the left-hand side have been met.

Example: THEN THE ANIMAL IS A FISH

If the premises are true or the conditions met, the right-hand side is also true. The rule is said to be triggered. Then when the right-hand side of the rule is implemented, the rule is said to have fired.

Each rule represents an individual chunk or piece of knowledge and they are usually associated with or related to many other rules. The rules link together to establish a line of reasoning. It is this network of rules that forms the knowledge base or rule base (common name for knowledge base).

Example: Rule 1 IF THE ANIMAL LIVES IN THE WATER
AND THE ANIMAL HAS GILLS AND SCALES
THEN THE ANIMAL IS A FISH

Rule 2 IF THE ANIMAL IS A FISH
AND THE FISH SPAWNS IN FRESHWATER
AND THE FISH MATURES IN THE OCEAN
THEN THE FISH IS ANADROMOUS (Certainty Factor = .9)

Expert systems usually deal with considerable amounts of uncertainty in their facts, rules, and definitions of the domain states. Where rules are used, measures of uncertainty can be attached to both sides of the (IF) clauses. Certainty Factors, confidence factors or rule strengths are used to indicate the confidence we have in the truthfulness or validity of the conclusion. These factors, usually subjective assignments of uncertainty levels on a scale from -1 to 1, are determined by the experts creating the knowledge base. Only the experts know how true or false something is or how confident they are of the various premises and conclusions in a rule. Most of the time these are simply intelligent estimates based upon experience. In some cases, reliable, statistical data may be available which will help the expert put a more accurate figure on the truthfulness or confidence of the information.

Once all the rules have been written, they are stored in the computers memory. The knowledge base then becomes the search space in which the inference engine will work. The inference engine is the mechanism that automatically carries out a search of the knowledge base for appropriate facts and rules to link together to form new facts and rules that eventually achieve the solution to the problem at hand. This mechanism examines the rules in a particular sequence looking for matches to initial and current conditions given in the data base.

The data base contains a broad range of information about the current status of the problem being solved. Known facts are stored and new facts that come to the surface through the inference process are added. The data base also stores a list of rules that have been examined, fired, and in what sequence this happened. This can later be given to a user to explain the reasoning process used to solve a problem or conclusion.

During the inferencing process, the expert system may reach out and access data in the spreadsheet or a data base management system to get enough knowledge to reach a solution. A geographic information system may be called to do a function or display a visual output. These various software systems can be linked through programming. Most expert systems support or provide this interface option to other data base structures or graphic tools. Large expert systems require data from existing data bases, results from the execution of other computer programs, or user interaction that requires existing graphic routines.

Expectations of expert system technology must be kept realistic. The selection of potential applications must be guided by strict consideration not only of the abilities of expert system technology but also of the current limitations. There are different ways to approach the development of an expert system: using computer programming language, which permits the most flexibility but requires very advanced skills; using an expert system shell where you merely add the facts and rules - this lacks any flexibility and cannot be used for any complex problem; or a compromise between the simplicity and restrictions of expert shells and the flexibility and cost of AI languages - which would be the use of a tool kit to ease development. What ever the approach, there are factors to be considered to help determine the suitability of a problem for an expert system:

1. Requires human expertise.
2. Has high payoff.
3. No common sense required.
4. Focuses on narrow subject.
5. No physical solution required.
6. Moderately difficult.
7. Can be solved with knowledge.
8. Has minimum number of solutions.
9. Experts are available.

Not all problems lend themselves to an expert solution. An in-depth analysis of the problem and need should be done to determine if a source of knowledge is a valid solution. There are nine major categories that fit expert systems. They are:

Control
Debugging
Design
Diagnosis
Instruction
Interpretation
Planning
Prediction
Repair

Finally, some steps to actually develop an expert system (one recommendation):

1. Identify the problem and need.
2. Determine the suitability of the problem.
3. Consider the alternatives.
4. Estimate the benefits.
5. Select a development tool.
6. Perform the knowledge engineering.
7. Design the system.
8. Complete the development.
9. Test and debug the system.
10. Maintain the system.

This should begin to unveil the potential Artificial Intelligence can have in natural resource management. Most of the work in natural resources has been in the form of advisory systems. Applying knowledge to solve specific problems in silviculture or pest management. Much project work has been done in both areas. Researchers in federal agencies and in universities are developing systems in wildlife management, pest management, fire, forestry and land management planning. Reports of much of this work can be found in the quarterly journal AI APPLICATIONS IN NATURAL RESOURCE MANAGEMENT. This is a good journal if you become interested in pursuing AI as a tool.

The Forest Service in cooperation with Texas A&M University has developed a southern pine beetle management system to provide advice on how to treat infestations of the beetle. This system is based on location and vulnerability of the area, it looks at the infestation and predicts what direction it will move in, how many times it will kill, and makes a recommendation on how to deal with it.

A system that integrates various technologies such as this is more often referred to as a decision support system. The limitations of stand alone tools to deal with natural resource problems are becoming increasingly apparent. The trend is towards an integrated decision support system using technologies as geographic information systems, remote sensing, and AI. Ill structured problems, like implementation and monitoring of Forest Plans are targets for a larger decision support system. There are no finished products to demonstrate this but prototypes are well underway in Regions 8 and 9. They are costly and labor intensive to design and develop these projects, but important to the future of our management needs.

We gain important information from every test we take with system development. The short term worth is always harder to rationalize then the long term gain. We have so many tools that are marketed as solutions to our land management needs, when in fact we know that the tool is just an implement to help us reach our solution. Artificial Intelligence is just another tool that is available to us.

Management of the Forests must answer the issues and concerns raised by the people over how the forest will be used. Information plays a vital role in communicating management objectives to the public. The use of advanced technology such as GIS, relational data base management systems and Artificial Intelligence helps our agencies effectively utilize information in natural resource management.

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CEA Project

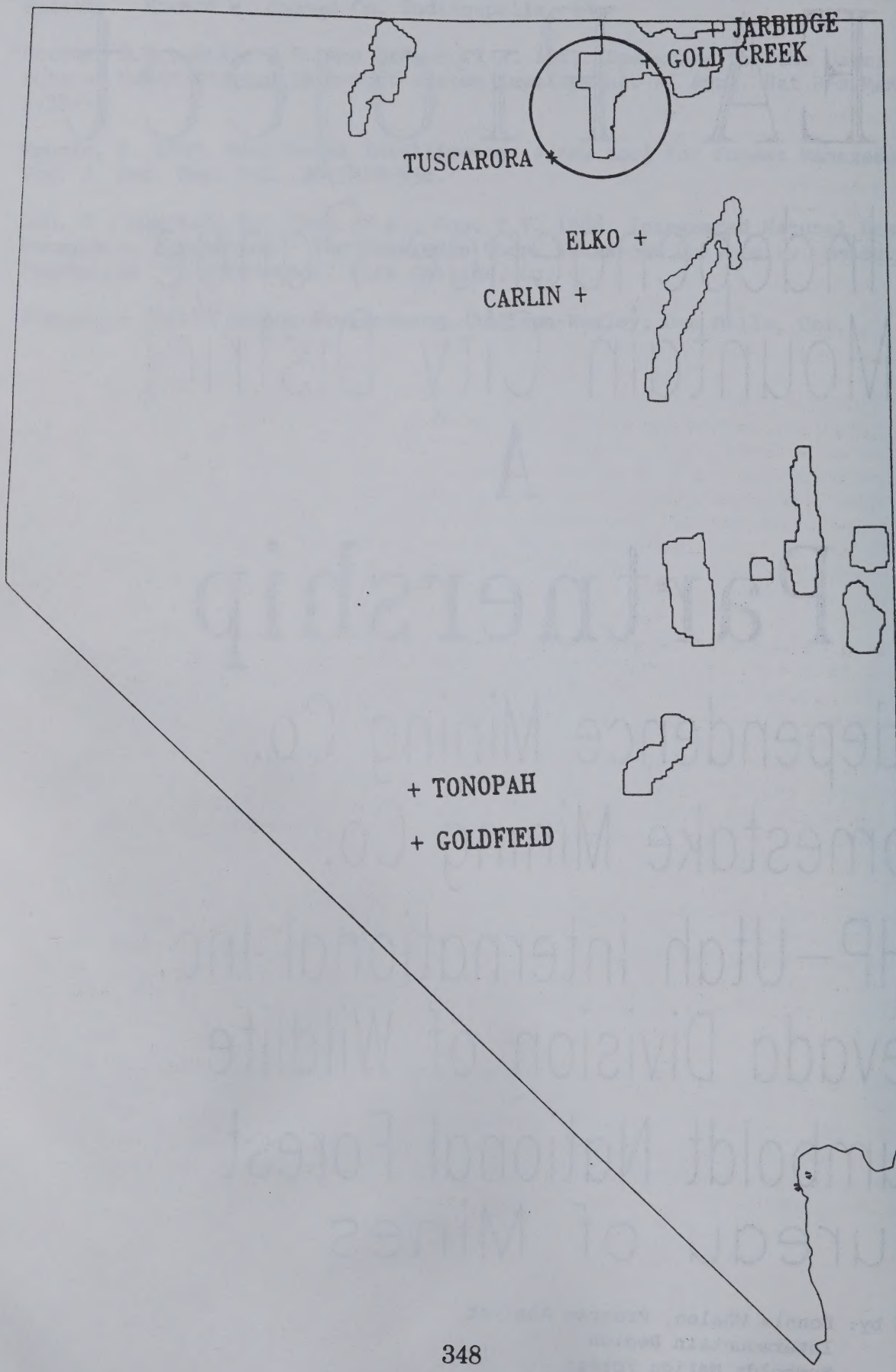
Independence Range
Mountain City District

A

Partnership

Independence Mining Co.
Homestake Mining Co.
BHP-Utah International Inc.
Nevada Division of Wildlife
Humboldt National Forest
Bureau of Mines

Prepared by: Bonnie Whalen, Program Analyst
Intermountain Region
Humboldt Nation Forest


JARBIDGE
GOLD CREEK
TUSCARORA
ELKO +
CARLIN +
+ TONOPAH
+ GOLDFIELD

CUMULATIVE EFFECTS ANALYSIS PROJECT
Humboldt National Forest
Mountain City Ranger District

The Cumulative Effects Analysis Project is a partnership project put together in an effort to find a way to address cumulative effects on the Independence Range. The partners in the project are:

Independence Mining Company (formally Freeport Mining)
Homestake Mining Company
BHP-Utah Internation, Inc.
Nevada Division of Wildlife
Humboldt National Forest
Bureau of Mines

The area for the project is the southern half of the Mountain City Ranger District on the Humboldt National Forest. The area is covered by the following USGS 7.5" quads:

Badger Creek	Bull Run Reservoir
California Mountain	Chicken Creek Summit
Delaware Creek	Dry Creek Reservoir
Jacks Peak	Maggie summit
Mahala Creek West	McAfee Peak
Mountain City	Ungina Wongo
Water Pipe Canyon	Wildhorse

The total land area within the study is 460,000 acres. This area include National Forest Service, BLM and private lands and was extended beyond the Forest boundary to include the alluvial slopes where mill sites and support facilities are often located. Only the 232,000 acres within the National Forest boundary was included in the detailed resource inventory, although the intent is to be able to assess impacts to all lands in the study area.

The Independence Range has a long history of mining and minerals exploration. In the 1840's people, in search of gold crossed Nevada headed for California. Prospectors made their way back into Nevada in the 1860's and early 1870's as gold deposits were discovered across the state. Several signigicant strikes were made in Northeastern Nevada, including Gold Creek and Tuscarora. There was some time of inactivity within the state then, in the early 1900's, Tonopah and Goldfield were discovered, at the same time there was another strike in Northeastern Nevada at Jarbidge. Rio Tinto Mine started producing copper in 1930 and was a producer for a number of years. During World War II The War Production Board shut down all gold mining operations and it wasn't until the 1960's that conditions became favorable again for active exploration for this type of ore.(Payne, 1976) With the advent of new technologies and processes to mine and mill microscopic gold and the discovery of several deposits of marketable gold in the Carlin area, exploration began on the Independence Range. (figure 2)

In 1980 an EIS was approved for the Jerritt Canyon mine and mill development. At that time cumulative effects were considered, however, the success of future exploration and additional mine development was not fully realized.

Since that time three additional mine complexes have been approved, with a Decision Notice just recently signed for a fourth project. Exploration has been extensive, with many miles of drill access roads. reclamation of these roads also has been ongoing.

In 1987, during the environmental analysis of the Wood Gulch mining proposal, the analysis of cumulative effect was questioned by interest groups, most specifically the Sierra Club. Following discussions with mining companies holding properties in the area, the CEA project was implemented.

Kim Barber a wildlife biologist who had worked on the Silver Fire Recovery Project and Grizzly Bear Model was working on the Mountain City District,at that time. Kim had some experience with GIS software and most specifically MOSS and he convinced the District Ranger and Forest Supervisor that GIS was the analysis tool that would be the most beneficial for this effort.

A partnership proposal was put together and taken to the mining industry. The agreement stated an analysis of cumulative effects will be conducted to support future mining project. The proposed project will produce a data base and computerized analysis tools for use in the required site specific analyses of all future projects. It also provides a way to display and measure cumulative effects. The analysis identified potentially impacted resources and levels of effect which cause concern. It allows the companies and the agencies to identify and measure disturbance levels and track reclamation over the study area. It also provides a way to reasonably predict the effect of future activities in the area The data base will provide accurate resource data for future project analyses with a minimum of costly field inventory. The result of the analyses will meet the objectives of the agreement and is expected to provide additional benefits as we learn to fully utilize the tools.

When the analysis was initiated early in 1988, a public scoping effort was undertaken. It was a full outreach effort with mailings, news releases and an information meeting. The following are the issues identified with that effort. As new project proposals are recieved some site specific issues may surface but the initial scoping was believed to include all those of a cumulative nature. Twenty two issues were identified during this scoping effort. All resource data needs were developed around thes issue areas.

Analysis Issues derived from Public Comment

1. Loss of visual quality
2. Reduction in recreation opportunity
3. Loss of public access to public lands
4. Increased recreation demands because of population boom
5. Direct or indirect removal of mule deer winter range
6. Direct or indirect loss of mule deer summer range and migration corridors
7. Loss of goshawk habitat
8. Loss of willow flycatcher habitat (riparian willows)
9. Loss of swainson's hawk habitat
10. Loss of habitat for cavity nesting species
11. Loss of sagegrouse habitat
12. Any effect on Lahontan cutthroat trout habitat

ISSUES

22 ISSUES IDENTIFIED

PROVINCES

ORDER OF STREAM BASIN TO A GIVEN DEER HERD RANGE

THRESHOLDS OF CONCERN

SHORT TERM -10 YRS
LONG TERM +10 YRS

UNIT OF MEASURE

ACRES OR MILES/CLASS
NUMBERS OF SITES

RESOURCE VALUE RATINGS

ATTRIBUTES OF THE HABITAT

COVER
FORAGE
ASPECT
SLOPE
HISTORICAL DATA

13. Any degradation of redband rainbow trout habitat
14. Degradation of habitat of other trout species
15. Ground water must continue to meet state/EPA water quality standards.
16. Any detrimental change to ground/surface water flow or timing
17. Surface water must meet water quality standards
18. Any increase in noxious farm weeds
19. Detrimental effects to vegetation species/communities of concern
20. Loss of AUM grazing capacity for permitted livestock
21. Disturbance of historic or prehistoric cultural resources
22. Disturbance of sites of concern to Native Americans

For every issue that was developed a province was delineated, a unit of measure was identified and both long term and short term thresholds of concern were defined. Thresholds of concern will be the indicator that something more or different should be done. TOC could also be a precursor to significance as related to NEPA.

The issues were then used to identified resourse data needs. Much of the data needed was on hand, although portions were outdated. Two area that appeared critical to our needs were some way of looking at future mining potential and a good solid data base for vegetation, both upland and riparian.

The first was taken on by the Bureau of Mines office out of Spokane. As a partner in this venture they put together a futuring analysis using Arc-info as their GIS software. The Bureau gathered drill hole information from both the mining industry and a season of work with their field crews. Using that knowledge as a basis for the analysis they have projected mineral potential into the future. They identified 18 potential areas for development with approximately 2000 acres of disturbance for the next 5 years and an additional 20 areas with about 1900 acres of disturbance for 5 to 10 year period. This reaffirmed the far reaching consequences so far as cumulative effects were concerned.

To meet the second need, it was decided to develop contracts for both the upland and riparian vegetation . This would enable us to analyse our data with state of the art software programs. The mining companies generously contributed the funding necessary to contract for these two inventories. Cedar Creek Associates, Inc. was awarded the uplands vegetation contract and all the field data was entered directly into the DG system on the Mountain City District. White Horse Associates was awarded the riverine riparian contract which they did using Arc-info. We have a poster display of the concepts used to develop the riparian data. We are still struggling with importing from one system to the other. Maybe I can get some ideas from any of you who have been successful in that area.

Some of the resource inventories are ongoing, such as a cultural resource inventory, which is usually conducted as a result of a specific project proposal. Areas of disturbance associated with exploration and mining, as well as other surface disturbing activities are inventoried and tracked through successful reclamation. Most of the disturbance, both exploration and mining are digitized from engineering plats provided through operating plan submittals by the mines.

Data for the project is stored in two formats. One is the digitized graphics data. The other is tabular data used to attribute or provide detailed information about the points, lines or polygons in the graphics file. For instance in the case of a road, the tabular information will tell you if it is an exploration road, if it has been reclaimed and if so what type of reclamation methods and seed mix was used for reclamation. etc.

Following is a list of data layers that are in project plus an explanation of the naming conventions:

GIS MAP LAYERS

RESOURCE DESIGNATOR	NAME	TYPE	QUAD/INDEP OR BOTH	ATTRIBUTED
AC	ACCESS	POLY	INDEP	NO
ASP	ARCHEOLOGY SITES	POINT	QUAD	YES/FROM ARCH DB
ASA	ARCHEOLOGY SITES	POLY	QUAD	YES FROM ARCH DB
AI	ARCH. INVENTORY	POLY	QUAD	NO
AL	ALLOTMENTS	POLY	INDEP	YES FROM RAMIS
BG	BIG GAME SU/WNT RG	POLY	INDEP	NO
NXT	MINERAL POTENTIAL	POLY	INDEP	YES
DIS	DISTURBANCES	POLY	INDEP	YES/RECLAMATION DB
DIS	DISTURBANCES	LINE	QUAD	YES RECLAMATION DB
DM	DIG.ELEV.MODEL(DEM)	RASTER/TYPE 8	QUAD	NO
SLP	*SLOPE	RASTER/TYPE 8	QUAD	NO
AST	*ASPECT	RASTER/TYPE 8	QUAD	NO
CTR	*CONTOUR	LINE	QUAD	NO
GS	GROUSE STRUTTING	POLY	INDEP	NO
FNC	FENCE & PIPELINES	LINE	BOTH	MAYBE IF NECESSARY
MDC	DEER CORRIDOR	POLY	INDEP	NO
	PLANIMETRIC--CARTOGRAPHIC FEATURE FILES (CFF)			
BM	**BENCHMARKS	LINE	QUAD	NO
HY	**STREAMS	LINE	QUAD	YES
LL	**LANDLINE	LINE	QUAD	NO
PND	**POND & LAKE	LINE	QUAD	NO
PIT	**PIT & QUARRY	LINE	QUAD	YES
RDS	**SYS. ROADS	LINE	QUAD	YES
SPR	**SPRINGS	LINE	QUAD	NO
UT	**UTILITIES	LINE	QUAD	NO
RP	RIPARIAN	POLY	QUAD	YES FROM RIPARIAN
RO	REC. OPPORTUNITY	POLY	INDEP	NO
SL	SOILS	POLY	INDEP	YES JENSEN'S INTERP
VG	VEGETATION	POLY	QUAD	YES FROM ECODATA DB
VI	VISUALS	POLY	INDEP	NO

** EXTRACTED FROM CFF *EXTRACTED FROM DEM

QUAD 5 LETTER NAMING CONVENTION

BADGR	BADGER CFEEK	BULLR	BULL RUN RESERVOIR
CALIF	CALIFORNIA MOUNTAIN	CHICK	CHICKEN CREEK

FILE AND MOSS PROJECT STRUCTURES IN THE OPERATIONAL SETTING

By Dan Wickwire BLM OSO 955.6

INTRODUCTION:

The file and MOSS project structures associated with the Western Oregon Digital Database (WODDB) have been somewhat cumbersome to work with in developing the western Oregon BLM Resource Management Plans (RMP's). This paper addresses whether these file and project structures should be changed in the operational setting (post-RMP) to provide a greater correspondence to the needs of the western Oregon BLM District users. Several subissues related to this problem are discussed in support of identifying a recommended alternative for providing a better solution than the current structure. This is a complex issue and may require further analysis and field input.

It was determined early in the project that the intensity of the western Oregon data required a township-level of resolution for many of the WODDB map themes. The data was too dense to allow formatting in larger blocks such as Resource Areas. The township-based themes were structured within adjusted Resource Area MOSS projects (see figure 1). Figure 1 illustrates the spatial relationship between the adjusted Resource Area projects and the administrative boundaries of western Oregon. MOSS township maps that are shared between Resource Areas were placed in the adjusted Resource Area project for the Resource Area containing the greatest percentage of the township. MOSS township maps that are shared between two districts (also two Resource Areas) were placed in the adjusted Resource Area project for the District managing the majority of the township and were also placed in a "shared" MOSS project on the other district's Prime. The township maps shared on the District boundary have created some redundancy in the data--each District has a copy of each shared township map

In the Operational setting we need to have a closer tie between MOSS file/MOSS project structure and field management responsibilities. The "unit of coverage" is an important concept here leading to the following question: "What mapping unit will most efficiently meet the needs of the western Oregon BLM District users?"

ASSUMPTIONS:

Currently the ADS master data for township-base maps is structured as single theme maps. For example, the WODDB map S20W08HYD has only one ADS theme--the hydrography theme. It is assumed that the operational ADS data will evolve to a merged file structure. This will consist of the merging of the most commonly accessed ADS maps (FOI, TPC, HYD, TRB, PLS, etc.) as themes within an ADS operational map. For example, the ADS maps (S20W08FOI, S20W08HYD, etc.) would be merged together into a new operational map named S20W08. This format will benefit the ADS update process. It is also assumed that only one copy of each ADS map would be maintained as the master data.

ALTERNATIVES:

A. Split WODDB operational MOSS maps on the District boundaries. This implies District-wide MOSS projects with each District directory containing only its portion of shared township maps.

B. Split WODDB operational MOSS maps on the Resource Area boundary. This implies Resource Area-wide MOSS projects with each Resource Area directory containing only its portion of shared township maps.

Note: A variation on the split options will also be discussed. This option would provide complete township maps to each District or Resource Area but only that District's or Resource Area's data would be present in their map. The adjacent District's or Area's part of the map would be "NULL".

C. Provide complete and duplicate MOSS township maps to each District who share that township. This again implies District-wide MOSS projects.

D. Provide complete and duplicate MOSS township maps to each Resource Area that shares that township. This implies Resource Area-wide MOSS projects.

E. Maintain the current system of "SHARED" MOSS data directories.

DISCUSSION ON RELATED ISSUES:

Subissue 1 At what level within the districts does the primary data user reside for the most dynamic and intensively managed WODDB themes? And which file and project structure best matches the use of the data in the districts? The organizational level will vary from theme to theme. Examples representing some of the most active WODDB township themes includes the following:

FOI--The primary user of the Forest Operations Inventory (FOI) theme resides within the Resource Area. The District Timber Manager has District level responsibility but each Area Silviculturist is responsible for the update and quality control of the ADS master data.

TRB--Origination of new roads information occurs within the Resource Area and for the most part this user is concerned with data solely within their own Area. Many issues do require access to adjacent maps and district reporting also requires aggregation of Resource Area queries.

HYD--The District staffs are using the HYD data primarily at a District level assessing cumulative effects of the timber harvest. These staff envision more use at the Resource Area level in the operational setting.

The most important issue in determining the proper file and MOSS project structure is unarguably the District and Resource Area users needs. As demonstrated above the user resides at different levels for various themes but the Resource Area appears to be the basic unit for the more dynamic themes. This lends support to closely tying file and MOSS structures to the Resource Area.

Subissue 2 How will the new system affect the total number of files that must be tracked and the total disk space used in the operational setting? There are 90 shared townships at the Resource Area level and 37 at the District level. For the 30± township-based themes, a Resource Area split would represent an approximate 20% increase (western Oregon-wide) in MOSS maps (increasing from 14,280 to 16,980). The District split would produce an 8% increase in township-based maps or an increase from 14,280 to 15,390. The latter is precisely the current level that we have with the "SHARED" directory structure. Both of these examples represent manageable increases.

Under either of the "split" options an appreciable increase in disk space usage would not be seen as each District or Resource Area would only have their part of the township and the only redundancy in data would possibly be the duplication of .AT files. This redundancy may not be an issue as the MOSS-Oracle bridge should allow each administrative unit to update their portion

of the Oracle table.

Providing complete township maps to each District or Resource Area would result in increased disk space used. Providing complete townships to each Resource Area would be the most significant representing an increase of 90 maps on the Prime network for each theme.

Some overall efficiencies can be expected upon moving to the operational ADS file structure. ADS polygon maps are comprised of 10-15 files, line maps are comprised of 5 files and point maps of 1 file. Initially, any alternative which would increase the total number of ADS maps (splitting ADS maps) would seem to greatly increase the tracking problems in ADS. These internal ADS files, however, are relatively transparent to the manual or automated tracking system. In addition, the merge of the current ADS maps to the operational structure reduces the total number of ADS files for the combined map. For example, if TPC, FOI, OWN, PLS, TRN, and HYD were merged as themes to the operational map S30W08 the total number of ADS files would be reduced from 75 to 50.

The split options increase the total number of MOSS files but this is within manageable levels. This increase may also be partially offset by operational decisions to take some of the township maps to the district format. The shift of the Spotted Owl Center (SOC) theme to a District format is an example of this.

The impacts to the total number of files and disk space used on the Prime network does not appear to be a driving issue to support one specific alternative. All the alternatives increase the total files to be handled in the system but do so within manageable levels. The options that allow for complete maps for shared townships for Districts or Resource Areas would generate increased disk usage and some awkwardness when doing analysis across the administrative unit boundary because of the redundancy of the files.

Subissue 3: If a split in the MOSS data is agreed upon should the merged operational ADS maps be split as well? ADS maps could be split to match a split on Resource Area or District boundary in MOSS. This split would simplify the update of the master data. It would increase total files as discussed above but as indicated this should not represent a major problem in a tracking system.

The ADS horizontal map structure (split or whole) is not necessarily dependant on the MOSS structure but a split structure would facilitate more straightforward updates to the master ADS data.

Subissue 4 What impact does the 1800 file limit per Prime directory have on determining the most efficient structure? The Prime currently has an approximate 1800 file limit for total WODDB files within a MOSS project. Subdirectories within a directory are considered individual entries counted toward the 1800 limit for the top level directory. This limit was one of the driving factors behind the adjusted Resource Area concept where hopefully this limit would not be exceeded.

With the current MOSS software, this is a valid argument for a MOSS project structure based on the Resource Area. MOSS currently looks down one level on the MOSSDATA disk to locate valid MOSS projects. These Prime directories must all conform to the file limit. It appears that one of two things would need to occur in order to use District-based MOSS projects. Either the Prime limit would need to be increased or MOSS would need to be enhanced to allow searching down a tree structure for valid MOSS projects. The path MOSSDATA>SALEM>S07W08 serves as an example. This MOSS project could include all township-based maps for S07W08 for the Salem District.

Subissue 5: How would raster processing be impacted under the split options? When processing raster or cell maps in the Map Analysis and Processing System (MAPS) each map must be windowed to a rectangle or square area. Splitting townships on District or Resource Area boundaries would leave an irregular boundary as part of the map perimeter which coincides with the administrative boundary. Splitting the MOSS map data between the administrative units while maintaining complete township perimeters could provide a solution to this requirement allowing for analysis in MAPS when the data was rasterized. Each District or Resource Area would have only MOSS and rasterized MAPS data that fell geographically within that District or Area. The area within the township perimeter that fell outside would contain "NULL" values.

With continuing limitations to the MOSS software, raster or cell processing will probably continue to be very important. This has significant bearing on operational file and project structure. The solution described above provides the split on Resource Area or District boundary but maintains a file format that is more conducive to raster analysis. Alternatively, the PER theme maps could be maintained as complete townships in each MOSS project for windowing purposes and other themes could be split without maintaining complete township perimeters.

RECOMMENDATIONS: ALTERNATIVE B.

Alternative B appears to be the only alternative that both meets the users needs and functions within the limitations of the MOSS and Prime softwares. This alternative does increase the total number of files to be tracked but this appears to be well within manageable levels. The recommendation of this issue paper is to do the following:

1. Structure the operational MOSS/MAPS project structure on the Resource Area.

2. Split shared MOSS/MAPS maps on the Resource Area boundary. A solution to the raster processing issue would be to maintain complete township map perimeters. Areas outside the Resource Area that are within the shared township perimeter would be given a "NULL" value. This is recommended.

3. Follow the same structure as above with the ADS operational maps. It appears that this would facilitate more efficient updates and edits to the master ADS data.

4. Test the recommended split in ADS.

OTHER ALTERNATIVES: The current system of "Shared" MOSS projects (Alternative E) is not a workable longterm project structure. The user needs all maps for a given theme to be in one project.

Alternatives A and C are also not workable because of the limit to total files in a MOSS project which would be exceeded in any district-based structure. A district-based structure also does not best meet the users needs in the field. The Resource Area appears to be the basic unit for GIS use within the districts. User needs must be one if not the most important driver for design of the system.

Both alternatives C and D would provide complete copies of the shared MOSS maps to both Districts or Resource Areas. These alternatives are not supported here because of the data redundancy that would be created and the increased disk space usage. These alternatives would also complicate analysis across administrative boundaries.

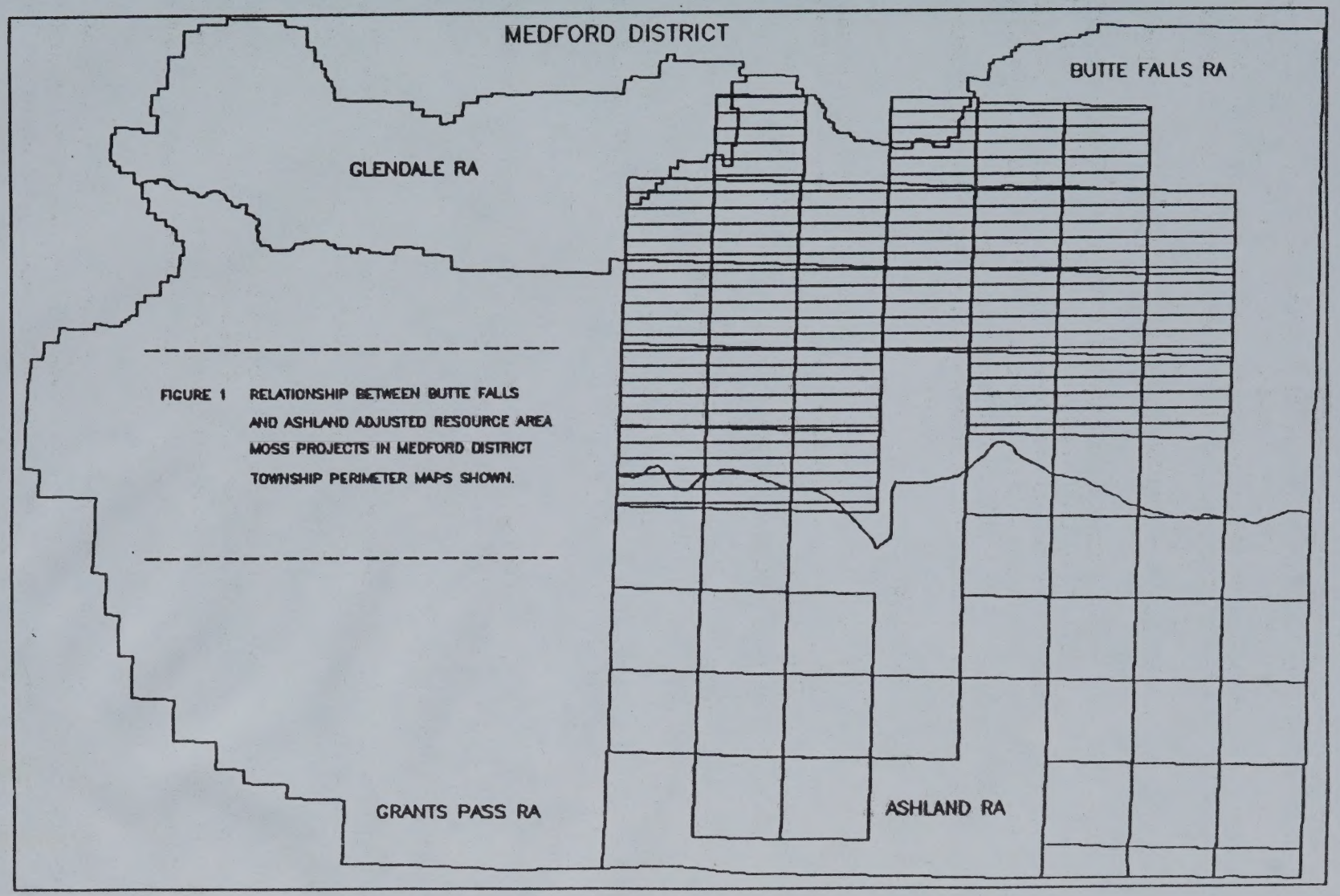


FIGURE 1 RELATIONSHIP BETWEEN BUTTE FALLS AND ASHLAND ADJUSTED RESOURCE AREA MOSS PROJECTS IN MEDFORD DISTRICT TOWNSHIP PERIMETER MAPS SHOWN.